SEVENTY-THIRD YEAR

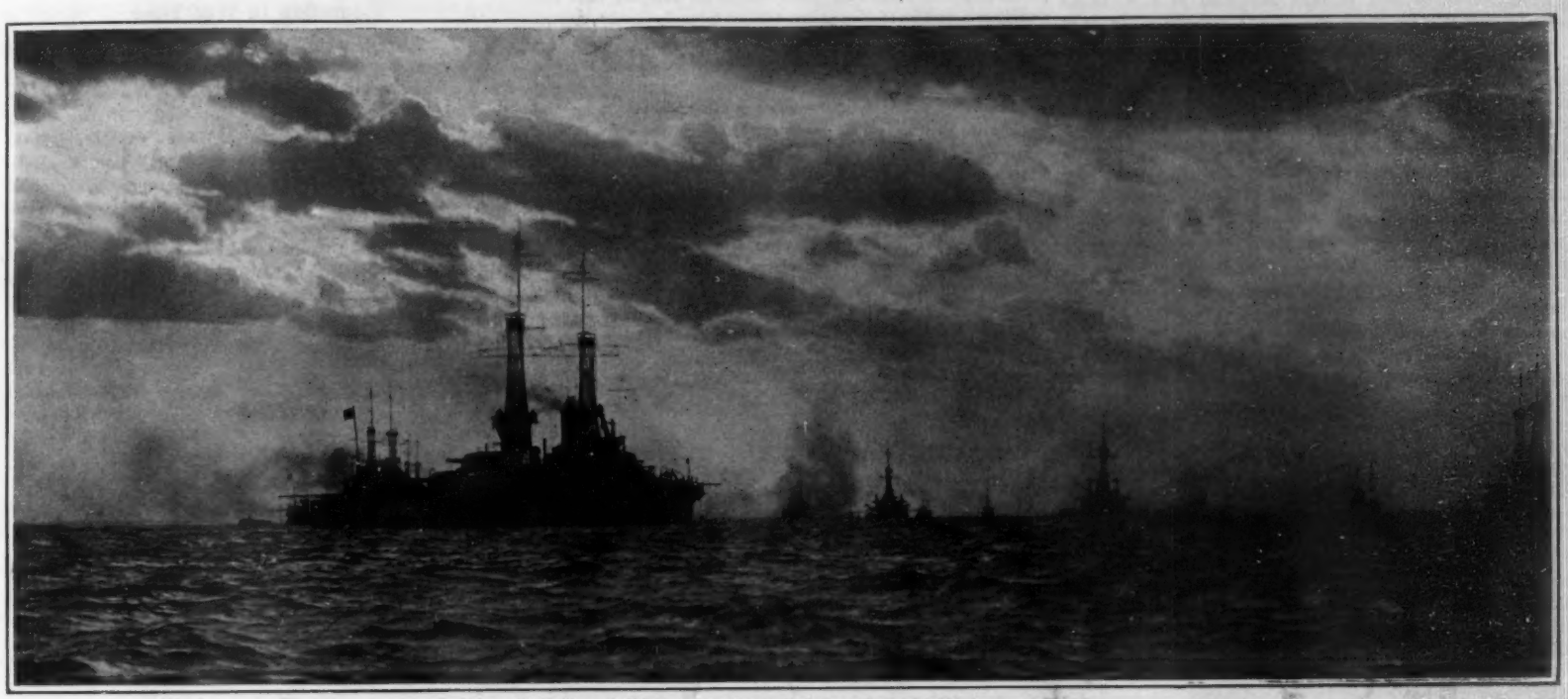
# SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXVII. NUMBER 9

NEW YORK, SEPTEMBER 1, 1917

10 CENTS A COPY
$4.00 A YEAR



Our Guardian Bulldogs—the best defence of our extensive coast line

## The Heels of Achilles

**By Walter Scott Meriwether**

IT is a recognized principle of our military and naval strategists that no aggression of an enemy can be successful until he has destroyed our battleship force; also that we cannot prevent an enemy from landing unless we prevent him with our fleet. One reason is that shore fortifications can defend only their particular neighborhoods; another rests in the fact that this country has upward of 21,000 miles of seaboard and that there is not enough money in the world to fortify the entire stretch.

Every undefended section would be a heel of Achilles as it would leave the nation vulnerable at that point. A board that had been delegated to inquire into this subject reported a year or so ago that there were 116 places where it was perfectly practicable for an enemy to land an invading force without hindrance from fortifications. Therefore any estimate of the amount of money that would be required to make our entire seacoast invulnerable to attack runs past the counting of man. It was not coast defense fortifications that kept the German heel from British soil. Nor can fortifications avail to fend invaders from our shores.

Yet in the estimated budget for war expenditure the largest single item of the enormous total was $2,468,613,000 for fortifications and sea-coast guns. Although we are not told that this is largely for field artillery, let us consider a moment what that sum could supply if diverted to other defensive uses. For example, it would be sufficient to construct 150 dreadnoughts and leave a balance big enough to maintain them for a longer period than the present war is likely to last. While there has been a rapid upbuilding of navies since the war began, yet it is doubtful if all the dreadnoughts in the world now total 150. Of this total the United States has 14 in commission and 5 nearing completion. If to this 19 were added 131 more, could any one conceive of any power or any group of powers, even though that group comprised every nation on earth, making an attack upon a nation defended by 150 dreadnoughts.

This is no effort to prove that we need 150 dreadnoughts. The contention is that if we are to expend an enormous amount of money for defense it would be wiser to employ that money in building dreadnoughts instead of putting it into forts. For a dreadnought is more powerful than any fort. It is a more efficient defensive weapon for the reason that while a fort is immobilized and can defend only the area within the range of its guns, a dreadnought can carry its more powerful battery to any threatened point and move to it with celerity. Expend $16,000,000 on an immobile fort and you have a fortification that may be able to fend off attack from its immediate neighborhood. Employ $16,000,000 in dreadnought construction and you have a steel mobile fortress which can rapidly move its tremendous power of offense and defense to any section of the coast, or move seaward to strike the foe before he can threaten the coast. Put another way, which is the wiser plan, guardian bull dogs that are chained to certain spots or guardian bull dogs that can rove singly or in packs?

With a preponderance of dreadnought strength no enemy will ever start from the other side to dispute that supremacy. His transports will remain at home for if he should undertake the extremely hazardous experiment of landing an army in the face of a preponderant naval force every condition would favor a great tragedy for the assailants. Doubtless an energetic foe would be willing to take any reasonable chance and pay any price for military success. But here the chances would be as nothing and the price would be stupendous.

There are many who have a notion that submarines when operating under the protection of shore fortifications are sufficient for all purposes of defense. So far as fortifications go, New York is the best defended of all our seaports. Yet it has been proven by the war games of the War College, that 100 submarines, if unsupported by battleships, could not prevent an enemy's

(Concluded on page 163)

The Atlantic fleet at anchor at Hampton Roads

# SCIENTIFIC AMERICAN

**Founded 1845**

**Published by Munn & Co., Inc., 233 Broadway, New York, Saturday, September 1, 1917**

Charles Allen Munn, President. Frederick C. Beach, Secretary. Orson D. Munn, Treasurer, all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office



*The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.*

*The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.*

## Safety First at Sea

IT is with a painful shock that we find confronting us, at this late date in the campaign of submarine warfare, the necessity of urging shipowners to safeguard their vessels against U-boat attack. We had supposed that these men would be using every precaution available to protect their vessels, their cargoes and above all, the lives of the crews.

The whole world, except Germany and her allies, has been trying to devise some means of combating the submarine. Countless suggestions appear in the Editor's mail every week from all corners of the earth. Every one is trying to save the merchant marine from the frightfulness of the U-boat; and yet we find that the owners of these vessels—not all of them we are thankful to say, but a shamefully large proportion of them—seem to care very little what becomes of their boats. At least, they are unwilling to go to any material expense for safety precautions.

Sixty years ago a non-sinkable vessel was built. We believe this vessel could sail across the Atlantic today and defy the attacking submarines. The vessel was described in our issue of August 18th—the "Great Eastern", whose hull was fitted with fifteen transverse bulkheads carried up thirty feet above the water-line. But on the grounds of economy, the construction of this vessel was not copied by other vessels. It was held up as an example of ultra-precaution. Maybe it was, for peace times, but we are at war now, when questions of economy should receive secondary consideration and the safety of a vessel should stand preëminent. Yet our emergency fleet is being built along the old lines with few bulkheads that barely run up to the water-line.

A prominent shipowner recently made the statement that it is more profitable to lose one vessel out of every twelve than to give up twenty-five per cent of the cargo-space in a ship. The loss is covered by insurance and represents no loss to the owner. Restriction of cargo-space represents a permanent, an unrecoverable loss to the owner. It is a national characteristic to take a chance, particularly where the returns are likely to be large. Even ship captains themselves often prefer to run a risk rather than to take the simplest precautions.

In a recent issue, we told of the zig-zagging course pursued by ships when in the infested areas; and described a simple apparatus which would enable the captain of a vessel to keep the boat on its course. Despite the known efficacy of such dodging many captains fail to depart from the normal straight course, merely because of the bother of keeping track of their whereabouts.

Strong Government action is needed to compel ship captains, and above all, to compel shipowners to use the simple and practical precautions that have been worked out. A mild effort in this direction is now being made by the Treasury Department, which has issued a set of requirements for all vessels sailing through the infested areas. If these requirements are not complied with the Bureau will increase the insurance premium by one-half to one per cent for each voyage, reserving the right to decline to insure those vessels whose owners have not, in the opinion of the Bureau, made a satisfactory effort to carry out the regulations. The vessels are required to be armed in accordance with the recommendations of the Navy Department. They must be painted in such a manner as to reduce their visibility at sea. They must carry enough smokeless fuel for use during the daylight runs while within the submarine zone. They must be provided with smoke boxes which will produce a screen of smoke when thrown overboard.

The threat to increase the rate of insurance may have some small effect but it will not necessarily compel compliance because few of the vessels are American, and many, even of the American vessels, carry British insurance or are insured by private companies. Not until the Government takes hold of the situation and enforces compliance with its requirements can we hope for any very material abatement of submarine warfare. This is a matter in which the whole country is vitally interested. The submarine is affecting America more than any other feature of the war. We are even curtailing our food supplies in order to offset the work of the submarine. Shipowners must give evidence of real coöperation or the public will call them to a serious accounting.

## Today's Warplanes versus Zeppelins

FROM Switzerland there are persistent rumors that even the great original Zeppelin docks of Friedrichshafen have been turned over to the wholesale manufacture of aeroplanes. Though the first of these rumors were denied by German authorities, who then declared that Zeppelin construction would continue unabated, the enormous aeroplane program of the United States lends plausibility to the tale.

But apart from that there seems no denying that the visible activity of Zeppelins has of late distinctly diminished, and that the list of Zeppelins brought down has increased. Yet it may be questioned whether this is to be the final state of affairs, or whether we are merely facing a parallel to the time-honored contest between armor and gun, in which both competitors have led alternately. The Zeppelin's apparent doom was sealed with the perfection of the inflammatory bullet for the machine gun. The only surprising feature of this development seems the fact that it did not take place earlier. Such bullets had been produced and tested well before the war in Germany, setting balloons afire. They were dismissed at the time with the superficial enough consolation that they could then be shot only from obsolete, large caliber rifles. When the war brought fighting between aeroplanes to its highest pitch, inflammatory bullets were necessarily perfected to serve as ammunition for small caliber machine guns, destined to ignite the wooden ribs and cloth of the planes and the gasoline in the tanks. The British soon realized what a terrible weapon they had thus incidentally provided against the elusive Zeppelins.

Trying to answer the question whether the Zeppelin's eclipse by the aeroplane be final or temporary, one recalls that British analyses of the debris of Zeppelins certainly point to a very crude state of anti-aeroplane defense. None of a rigid dirigible's inherent possibilities were taken advantage of. Instead these defenses were copied from the machine-gun equipment of aeroplanes. To mount machine guns in close proximity to vibrating motors is a necessary evil in aeroplanes. But there was no reason, except enforced haste in designing, why this pernicious habit should be continued in dirigibles.

The keynote to Zeppelin defense will forever be in its undoubted nature as an ideally perfect gun platform. Just as positions for ponderous, vibrating motors have recently been constructed at any point along the extensive frame, so positions for field cannon may be constructed anywhere. If the tremendous load of bombs, formerly carried, is reduced, weight is no hindrance. The weapon needed would seem to be a high powered machine cannon, capable of accurate long-distance fire, and discharging a tiny shell of which a single hit in any part of its structure would be certain to down an airplane. This demands a high explosive shell just large enough to tear away, by exploding anywhere within "touch", so much of an airplane that its flying power is destroyed. But Krupp had designed, many years before the war, a percussion fuse that would explode upon striking something no more substantial than balloon cloth. Accordingly, a more formidable problem of the shell in question might be found in the extremely sudden explosion it demands. Old-fashioned percussion shells had a habit of going to pieces only *after* piercing the target. In spite of its sensitive nature the shell must be capable of being absolutely secured against explosion before leaving the barrel, in order to be handled with impunity by the mechanism of a machine gun.

Such machine guns, would of course, not rattle incessantly, but on account of their heavier ammunition, fire short "bursts" of 8 to 12 shells each. Contrary to the old "pompom," high-muzzle velocity, flat trajectory and extreme accuracy at long range would be paramount, also a greater rapidity of fire.

A *sighting machine* automatically scattering the shells of one burst evenly and closely might prove the solution of all remaining problems. Why should, with such weapons, more than the skill of a crack trapshooter be required to down any "Aeroplane De Chasse" before it can get near enough to harm even a Zeppelin? We know from airplane fights that it is by no means very difficult to get a bullet hole somewhere through an airplane. It is only so hard to touch a vital spot. With proper Zeppelin cannon what otherwise would be merely a hole through an aileron would spell disaster.

Another vital advantage of the Zeppelin in air fighting must be pointed out. The greatest dread in airplane actions is the comparative ease with which an enemy's machine might steal unobserved into close proximity, due to the short time taken by evolutions at racing speed coupled with the cramped and obstructed view from an airplane; on a Zeppelin, on the contrary, it can very easily be arranged that space in every direction is kept under such constant close scrutiny that not a humming bird could approach unseen.

Trying to fight with the weapons and methods of an airplane, a bulky, comparatively slow, highly combustible Zeppelin seems hopelessly handicapped. But let it only learn, like the fledgling swan among the ducks in Andersen's instructive fairy tale, to develop its own resources and do the very opposite to what its well-meaning foster-parent has taught. Distribute observers, ship the best trap-shooters available, shoot at 2,000 yards with machine cannon and shells. With these, the perfection of which is certainly no harder a problem than that of the delicate motor which made the "Aeroplane De Chasse" possible, the Zeppelin among war-planes is like a white man among savages; as long as he keeps a wide stretch of open space around himself, he may kill any foe before the latter is within his own range.

## Education In War Time

VARIOUS complex problems present themselves in connection with the conduct of our schools and colleges during the war. This fact is fully recognized by the Council of National Defense, which convoked a large assembly of university officials in Washington last May to consider the situation, and subsequently also sought the advice of representatives of secondary schools. At the present time there is a strong Education Section connected with the Advisory Commission of the Council of National Defence, and it has held a series of meetings in Washington. This section, together with the Bureau of Education and the States Relations Service of the Department of Agriculture, constitutes a connecting link between the educational institutions of the country and the national government in matters pertaining to the war, and also provides the machinery for an interchange of opinions among educators and such concerted action as may prove feasible.

As a partial guide toward the adoption of a wise procedure we have also the object lessons afforded by the experience of our European allies. In retrospect it is easy to see that they committed serious blunders with respect to wartime education, due chiefly to the fact that, when the war began, the opinion prevailed that it would be of short duration. We must not repeat these blunders.

It is especially within the sphere of the SCIENTIFIC AMERICAN to consider how scientific and technical education is and ought to be affected by the war. Perhaps the most important point about such education is that the persons now receiving it will be called upon to perform extraordinary services to their country and to the world—and incidentally will enjoy extraordinary opportunities for their own advancement—*after* the war. This capital feature of the situation is well brought out in a recent circular issued by the Commissioner of Education.

"When the war is over," says Dr. Claxton, "whether within a few months or after many years, there will be such demands upon this country for men and women of scientific knowledge, technical skill and general culture as have never before come to any country. The world must be rebuilt. This country must play a far more important part than it has in the past in agriculture, manufacturing and commerce. . . . Russia and China are awakening to new life and are on the eve of great industrial development. They will ask of us steel, engines and cars for railroads, agricultural implements, and machinery for industrial plants. They will also ask for men to install these and to direct much of their development in every line."

The supply of European scientists and technologists is already enormously depleted. The war has taken dreadful toll of both student-bodies and faculties at Old World centers of learning, and has also debarred an immense number of the younger generation in the belligerent countries from the advantages of a higher education. The moral of all this is that, instead of merely keeping our universities and technical schools up to their normal attendance—as urged by most persons who have discussed wartime education—we should make every effort to *increase* their attendance.

If we are in for a long war, then it is equally important from a military point of view to add to the brain-power of the nation by increasing the attendance at universities, colleges, normal schools and technical schools—now constituting little more than one-half of one per cent of the total population of productive age. Tuition fees should be lowered as much as possible. The hours of classes and the length of course should be arranged so as to give students greater opportunities for "working their way" through college. The abolition of the long summer vacation and the adoption of a school year of four terms of 12 weeks has been suggested as a means of enabling some students to complete their educations more rapidly and others to give a larger proportion of their time while in school or college to productive work. We must have more and more technically trained men, whether for war or peace—more doctors, more engineers, more experts in every line.

## Automobile

**Tire Substitutes in Germany.**—Rubber is so scarce in Germany that little or none can be spared for tires for motor vehicles. To take its place various kinds of spring wheels have been devised, both for cars and for bicycles. What success these devices have met with is not known, but the experience gained may very possibly result in the continued use of this description of wheel for some classes of vehicles after the war is over.

**Joy Riding by British Officers.**—Joy riding, in goverment cars, by British army and navy officers, as well as by civilian officials, has at last become a public scandal; and the practice during a time when the general public, and even business houses, are not allowed enough gasoline for their actual necessities is particularly aggravating. It is a species of petty grafting that is practiced all over the world, but that does not palliate the custom. It remains to be seen whether our goverment will take steps to prevent such abuses of office, or wait until they become too notorious to be ignored.

**Selecting a Driver.**—An English automobile publication, in discussing the qualifications of a driver, for either pleasure cars or trucks, quotes the experience of a large employer who said that, other things being equal, he always gave the preference to the man who had owned a motorcycle. Among his reasons for this were that a motorcycle owner understood something about the need for economy in gasoline and tires. Moreover, he had experience in driving an engine that requires more careful operation than the water-cooled auto engine, and consequently was more sensitive to any bad running of the engine; besides having a good idea of adjustments and repairs.

**A Step Toward Greater Economy of Fuel.**—In these days of multi-cylinder engines there is one improvement that could be easily introduced, which would promote their efficiency, and at the same time their economy of fuel, and that is to increase the compression, and to do this more careful attention would have to be given to the cooling to avoid pre-ignition. Pre-ignition usually is caused by the overheating of some particular point within the cylinder, as the spark plug, a valve head, the piston head, or some projecting edge of the gas passages. A careful redesigning of the arrangement of these parts to secure more effective water cooling would overcome the present difficulties, and permit of higher compression; and this is already being done in the latest aircraft engines.

**Simplified Change Gearing.**—It has long been recognized by some people that the present gear shifting mechanism, found in practically all makes of automobiles, is not only inconvenient and inefficient, but actually a very crude piece of mechanism. In short, it is a very clumsy makeshift, and a serious blot on motor car construction. It is stated in the English automobile papers that several devices are being developed in that country which will not only be simpler to build, but will eliminate all the guess-work and special experience required to operate the present system, and that these devices will be ready for incorporation in British cars as soon as the war is over. Now is the time for American designers to attack the problem seriously if we are to maintain our position in world trade.

**The Opportunity of the Electrically Driven Vehicle.**—The increasing shortage in petroleum fuel, which threatens to become acute, offers a great opportunity for the wider introduction of electrically driven vehicles, which depend for their supplies on power developed by other classes of fuel, or water power. The electric vehicle is by no means an experiment, for it has performed most satisfactorily for a number of years, for both pleasure and commercial purposes, and has proved itself eminently practical. This the public does not appear to be generally aware of, as the more spectacular or sensational features of the gasoline car have monopolized attention; but impending conditions will undoubtedly force a wider recognition of the undoubted merits of the electric vehicle.

**A Sign Which Protects Automobiles Against Theft.**—Margarita Schumacher, in devising a means of preventing automobile theft, has done away with the usual locks, chains, brakes and other devices which usually go to make the automobile theft-proof in theory if not in fact. This woman inventor of Los Angeles, Cal., goes about the problem from a new angle, and substitutes a simple sign for all manner of safety locks and chains and brakes. She suggests the use of a simple shade normally held in position on a roller mounted on the windshield, and pulled over the windshield when the car is to be left standing. The shade is made of opaque material, and bears on its front face the legend "This car is stolen if in motion." Means are provided for holding the shade in position during the absence of the owner; and it is evident that with an opaque screen before him and the sign announcing that the car is stolen, a thief could not get very far with a stolen vehicle.

## Science

**The Secretion of Nectar in Plants,** a process of much practical interest on account of its relation to bee-keeping, has been the subject of many investigations, beginning with those of G. Bonnier, in France. A recent bulletin of the Iowa Agricultural Experiment Station, by L. A. Kenoyer, presents a handy résumé of all the work in this line up to date, including a series of investigations made by the author. Among the facts thus far ascertained are the following: The secretion of water but not of sugar from the nectaries is increased with increasing atmospheric humidity. Dilution and washing by rain result in the loss of much sugar from nectar. The rate of secretion of both water and sugar increases with atmospheric temperature up to a certain optimum, but the most favorable condition for sugar secretion is an alternation of low and high temperatures. Nectar is most abundant early in the blooming season, other things being equal. Accumulation and secretion of sugar are most pronounced near the time of the opening of the flower.

**Book Publishing in the United States.**—A summary of book publishing in the United States during the period 1890-1916, just issued by the Bureau of Education, shows that the output did not vary much until 1900, when a marked upward tendency began, culminating in 1910, in which year 13,470 titles were recorded. The effects of the European war were shown especially in 1915, when the number of books published was only 9,734, but in 1916 the number rose to 10,445. The panic of 1893 was followed by a decrease of books in 1894, and the Wall Street panic of 1907 appears to have been responsible for a slight decrease in 1908. Fewer than one-third of the books published in this country are by foreign authors. The most surprising feature of the record is the fact that there has been for many years a marked decrease in the number of works of fiction published annually in this country, both absolutely and in proportion to the total output of books. Perhaps this is a healthy sign, and then again perhaps it is a token of the increasing sternness and strenuousness of life in these United States.

**The Revegetation of an Island.**—When the present Salton Sea was formed by floods from the Colorado River in 1907, a certain hill was so nearly submerged that its summit was repeatedly washed by the slightly salty water. All the vegetation on the hill was thus destroyed and all seeds were sterilized. This hilltop, now known as Cormorant Island, is two miles from any other island and still farther from the main shore. Under the direction of Dr. D. T. MacDougal, in charge of the Desert Laboratory of the Carnegie Institution, the revegetation of this barren island has been observed with more care, probably, than has ever before been expended by naturalists upon the investigation of a similar process. In 1908 two plants were found growing on the island; viz., one specimen each of *Pluchea sericea* and *Baccharis glutinosa*. In 1912 there were 33 plants of six species, and in 1916 470 plants of ten species, while one of the species observed in 1908 had disappeared. The methods by which seeds were brought to the island included transportation by wind and water, but apparently not by birds, after the manner concerning which so much has been written by Darwin and others. Besides the transportation of seeds, it appears that seedlings of *Sesuvium* and *Spirostachys* may float about for some time and take root when cast ashore; a method of plant dissemination which seems not to have been previously reported.

**"Fishiness" in Milk Products.**—The fishy flavor observed sometimes in milk and frequently in butter has been the subject of a great deal of investigation, but its origin has remained obscure. The evidence has heretofore been against bacteria being the direct cause of the trouble, and has indicated that changes in the product favored by high acidity and the presence of oxygen were responsible for the objectionable flavor. O'Callaghan attributed the defect to *Oidium lactis*. Weigmann considered that fishiness might develop from abnormal working and sometimes also from the use of salt high in magnesium. Several experiments have appeared to indicate that specimens of fishy butter would not communicate their flavor to good butter placed in contact with them. There has been conflicting evidence as to whether the flavor occurred in unsalted as well as salted butter. The latest contribution to this vexed question has recently been made by Mr. B. W. Hammer, dairy bacteriologist at the Iowa Agricultural Experiment Station. From a can of evaporated milk that had developed a fishy odor he isolated an organism that was capable of producing fishiness in milk, cream or evaporated milk into which it was inoculated. In milk so inoculated there was, besides the development of the fishy odor, a coagulation and a rapid digestion. The organism did not, however, produce fishiness when inoculated into butter, either directly or into pasteurized or sterilized cream before churning. The organism, which appears to be closely related to the *Proteus* group, has been named *Bac. icthyosmium*.

## Invention

**Which Is It—Motorcycle or Automobile?**—With the body and general appearance of an automobile roadster, the two-wheeled vehicle recently patented by Earle L. Whitehall of Denver, Colo., is indeed a unique machine. While the machine is standing still extra wheels, mounted on hinged members, are let down so as to support the vehicle in an upright position; but when under way the automobile-motorcycle makes use of two wheels only.

**A Magazine Pipe.**—Simulating the present-day magazine rifle the magazine pipe of James H. Hoefler, Louisville, Ky., makes use of a spring-operated magazine which continues to feed tobacco into the bowl as fast as it is consumed. The pipe makes use of a casing communicating with the bowl, a magazine mounted within the casing and formed of telescopic sections of graduating diameter and spring means between the casing and magazine for telescoping the sections.

**A Permanent Car Fender.**—To a woman inventor, Mary J. Iverson of Beverly, Mass., belongs the credit for having designed a practical fender for street cars, which remains permanently in place. The fender is made up of stout rods, and is permanently fastened to the car dash by welding or other means. Extending from beneath one doorstep completely around to the other doorstep, this fender makes it practically impossible for any article to get under the car wheels.

**Hand- and Foot-Operated Headlight Dimmer.**—Working on the automobile headlight problem for some length of time, Arthur K. Weiderer of Chicago, Ill., has succeeded in perfecting a mechanical dimmer of simple construction. Dimmer members in the form of shades are raised and lowered in the headlights by bars and levers connecting with hand- and foot-operated controls within convenient reach of the automobile driver. Thus it is possible for the driver of a car so equipped to dim the headlights at will by a simple movement of his hand or a slight pressure on a pedal.

**A Gimlet Screw.**—Evidently Charles D. Woodward of Providence, R. I., has often had considerable trouble in driving the conventional wood screw into hard wood, for he has developed a screw which bores its own hole as it proceeds. According to his patent claims, he has devised a countersinking gimlet-pointed screw having at the root of its point a bulge constituting the largest diameter of the shank, and having across its thread a spiral groove one end of which forms a cutter at the bulge. The groove goes once around the screw and terminates at the slant of the head and at the root of the gimlet point.

**Method of Rectifying High-Tension Alternating Currents.**—From the small town of Randwick, near Sydney, Australia, comes a novel suggestion for rectifying high-tension alternating currents by means of an ingenious spark gap. Archibald Shaw, the inventor in this instance, suggests a rectifying spark gap, comprising a metal blunt-nosed cone which forms one electrode of the combination, and a substantially flat member spaced axially from the smaller end of the cone and forming the other electrode. The cone has a small longitudinal bore and is provided with means for discharging gas at a high velocity through the orifice of the cone member, against the flat electrode.

**A One-Wheeled Motorcycle.**—Louie G. Wilson, *Morning Sun*, Iowa, has been granted a patent on a one-wheeled motorcycle or automonocycle, as it is called. His patent claims cover "in a monocycle, a supporting wheel, an axle, a frame mounted on said axle, and steering means including a gyroscope casing adapted to support a gyroscope therein for rotation in a vertical plane with the axis of rotation extended at right angles to the normal direction of travel of the monocycle, a pair of arms pivoted at opposite sides of the frame for independent oscillation in a vertical plane, and for supporting between their terminals the casing and levers formed on said arms, whereby to tilt the casing, whereby the supporting wheel may be rotated about a vertical axis, in one direction or the other, to change the direction of travel of the monocycle."

**How You Would Look in That Suit.**—The usual window display of garment dealers and tailors takes the shape of a number of suits mounted on elaborate stands for the inspection of the passersby. But the average passerby whose attention is arrested by any of the garments, is interested in only one thing: How would he look wearing them? To the end of answering this ever-recurring query, Charles H. MacQuesten of Bloomfield, N. J., has invented a simple mirror device which permits any passerby to "wear" any garment on display. Briefly, his device consists of a mirror held in position by an adjustable support so as to be in line with the top of a garment placed some distance behind it. Thus, when the passerby stands facing the garment, his head is reflected by the mirror in such a manner that it appears to fit on the garment behind, completing the desired illusion.

# Robbing the Arctic so that Montana May Drink

## How the St. Mary River Was Shifted from the Hudson Bay Drainage System and Made To Flow into the Missouri

THE transference of a river from the drainage of one ocean to that of another has just been accomplished by the engineers of the Reclamation Service. St. Mary River, which heads among the highest peaks of Glacier National Park, until this month was shown in our geography as belonging to the drainage of the Arctic Ocean. By clever engineering it has just been transferred to the drainage of the Atlantic.

Born among the eternal snows and the wonderful glaciers of northern Montana, St. Mary River for ages flowed northward across the international boundary, where it mingled with numerous other affluents and finally lost itself in Hudson Bay. Nowhere in its own valley in this country were its waters available for irrigation. East of the valley in Montana, and separated from it by a low range of hills, another river had its source in the great plains in two forks, one of which was only 28 miles away. This stream, known as Milk River, having no mountain drainage, is erratic and uncertain in its flow, and subject to flashy floods and long periods of drouth. Like the St. Mary, it flowed northward across the boundary, but, unlike the former, it finally returned to the country of its origin to join the Missouri in northeastern Montana. In its lower valley are hundreds of thousands of acres of fertile level land capable of supporting many families, which under irrigation will produce enormous crops of grain, hay, and sugar beets. To augment the insufficient flow of Milk River by turning into it the stored waters of the St. Mary was an engineering problem comparatively easy of solution. The engineer had but to provide the necessary storage system for holding back the St. Mary, and then, by means of a large canal cut through the divide, pass these waters into the Milk River, whence they would flow to the irrigable areas in the lower valley.

Right in the beginning of working out a plan for utilizing the St. Mary River the engineer was confronted with an apparently insurmountable obstacle. There was Canada, with a possessory right to waters from streams and with an abundance of land upon which to use the same. It would avail the United States nothing to store the St. Mary River in order to enlarge the flow of Milk River unless assured that this increased water supply would be permitted to reach the lower valley in Montana. Representatives of the two governments met at Quebec on several occasions, and as a result of these conferences a treaty was drawn up which on May 13th, 1910, was ratified by both nations. This treaty provided that in consideration of the use of the channel of Milk River in Canada as a carrier, the combined waters of Milk and St. Mary rivers should be equally divided between the two countries.

With the removal of international obstacles the engineers immediately proceeded with construction. The St. Mary storage works are nearly completed, the canal has been excavated, and this month the waters which once fed the Arctic have been mingled with those which ultimately reach the Atlantic. The land conformation is such that this canal had to issue from the St. Mary on the wrong side of the river, and be carried along the side of the valley, at a constant level but ever higher above the river's retreating surface. An interesting feature of the work is the big siphon by means of which the stream is carried back, across its own former valley, to the east side where it is wanted. As these waters flow through Canada, a part is turned upon the thirsty soil of our neighbor. Farther down in the beautiful valley of the Milk River in Montana an extensive system of dams, reservoirs, and long canals is nearing completion and already is bringing to ripening thousands of acres of grain and hay.

The reservoirs in the lower valley are as follows: Point of Rocks, Beaver Creek, and Nelson. These reservoirs will be filled during the flood periods. Two large diversion dams have been placed in the river at Dodson and Vandalia, and another will be constructed at Chinook. From these reservoirs and dams an elaborate system of ditches will carry the water to the irrigable lands extending from Chinook to Glasgow, a distance of 140 miles. Excluding the St. Mary Canal, the mileage of canals and ditches to serve the valley will be 273. The total area to be irrigated is 220,000 acres, of which 29,500 acres are unentered public land.

**Blackfeet Indians employed in the work of construction and road building**

**Lake McDermitt and Falls, a storage reservoir on a tributary of the St. Mary**

**The big siphon which carries the waters of the St. Mary across the valley and the old river bed**

The Milk River valley has a general elevation of 2,200 feet above sea level, and an average annual rainfall of 14 inches. The temperature ranges from 52 below to 103 above zero. The soils are sandy loam, clayey loam, and some gumbo. Owing to the generally level character of the irrigable areas the cost of preparing the land for water is slight. Climatic and soil conditions are admirably adapted to the growing of wheat and oats, timothy and alfalfa, potatoes, sugar beets, etc. Live stock and dairying are profitable. Markets for all products are furnished by Minneapolis, St. Paul, Great Falls, Butte, and local towns.

With the assurance of an abundant water supply the Milk River valley is entering upon an era of progress and development which will soon place it among the rich and prosperous agricultural districts of the Northwest. Owing to the comparative cheapness of lands and the opportunity which will soon be made for settlers on public lands, the valley should attract many homeseekers this fall.

### Rice Yield Ruined

**By Rozel Gotthold**

THE salt water of the Gulf of Mexico has invaded the rice fields of Louisiana, and has ruined the 1917 crop, bankrupting many of the planters, who, sure this year of good prices, staked all they had on rice. There are almost half a million acres in the rice belt, which is the low marshy stretch of land lying along the Gulf. According to government figures, based upon last year's yield, it would have produced over seventeen million bushels, bringing, at $1.50 a bushel, cash returns amounting to about $26,000,000.

The belt is fed by irrigation canals drawing their water from the Mermentau River, and its tributaries, and from the three lakes, Arthur, Grand and White. The Mermentau River has a wide-spreading mouth, into which, at low stage, flow the waters of the Gulf of Mexico, which contain almost 2,000 grains of salt to the gallon. But only 35 grains, at the most, will kill rice. To protect their irrigation from the Gulf salt flow, the rice people obtained, more than a decade ago, permission from Congress to build locks at or near Grand Chenier. They put up construction that took care of the usual tide, and managed abnormal flows. This was the solution of the whole problem, as far as the rice planters were concerned, but the farmers of Grand Chenier thought that the dam piled up the waters in their section, and would make them more liable to overflow.

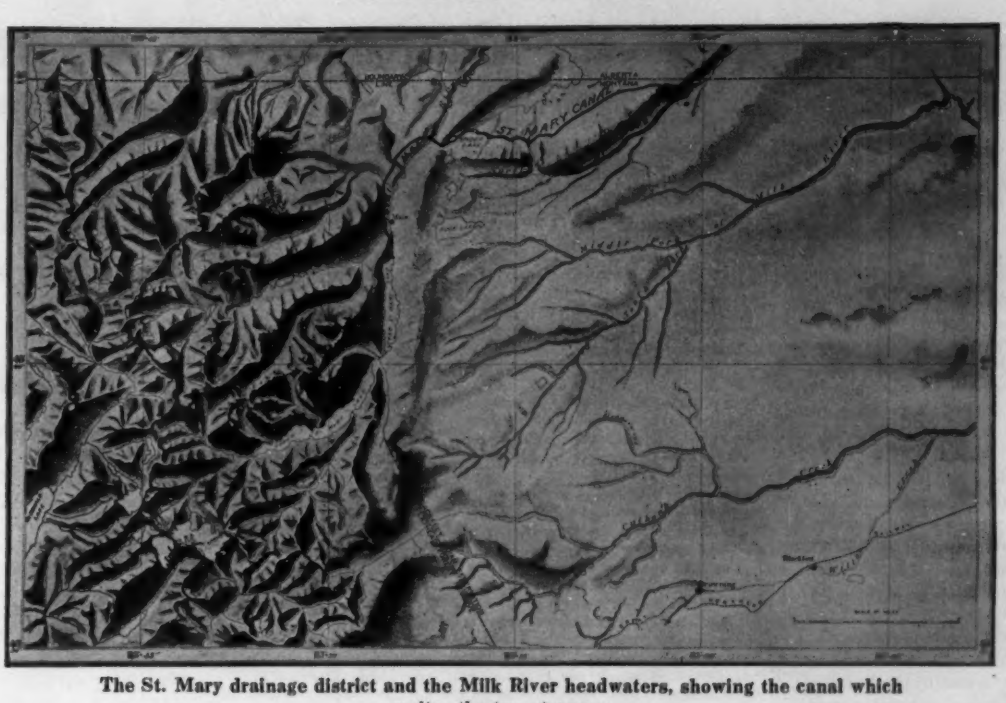
Shortly afterward, there were several explosions of dynamite, and the dam was wrecked. Twice it was repaired. The third time, nothing was done, but there was left in the river the remains of the dam, which still kept out the usual tide.

It was removed, however, as an obstruction to navigation, and then the rice people were left unprotected. Every year they have counted upon the heavy southern torrential rains to dislodge the salt from the fields, and they have, until this year, won out. But the past June was a record dry month, and when an average rainfall came at the end of the month, it was too late to do any good. The irrigation plants had already been closed, and the salt had done its work.

All the inhabitants of the region, which lies in the parish of Cameron, united, under this catastrophe, and delegations were

sent to Washington asking federal aid. They have presented a plan for tapping the waters of the Mississippi and Atchafalaya rivers, which however, requires money and time for legislation.

The immediate need is so great, that they have turned to the simplest way out, which seems to be to take some of the approximate $150,000 appropriated by Congress for improvements in the eastern end of the Inter-coastal Canal around Franklin, and turn it into the construction of a lock at the western end, on the lower side of Grand Lake.




**The St. Mary drainage district and the Milk River headwaters, showing the canal which unites the two streams**

## Moving Forms for Concrete Elevators

**By R. P. Crawford**

THE rapid adoption of reinforced concrete for grain elevators is apparent in nearly all parts of the country. Because of the great fire risk the old-fashioned wood elevator is being discarded except at country points and even the more modern forms of steel, tile and brick construction have felt the steady encroachment of concrete. Adaptation of concrete to grain elevators has brought with it the introduction of moving forms, which make elevator building different from nearly every other line of concrete work. Generally speaking, in ordinary construction concrete is poured in a form and left to set. Later the form is taken away and may be used elsewhere. But in the case of elevators the same set of forms does continuous service from the time the elevator is started on the ground until the top level is reached. The forms by means of jacks and steel rods are raised up the very walls that they have constructed. This is not only going on from day to day but even from hour to hour.

The working floor at the top of the elevator is of wood, cut here and there by grooves into which the concrete for the bin walls is being poured, and surmounted by several dozen jacks, by means of which the forms and floor, are elevated. Elevating the concrete mixture on a hoist and distributing it to the forms is an easy matter. The system of jacks, usually screw jacks, is the interesting part of the procedure. These operate on steel rods imbedded in the bin walls. These rods are gradually lengthened as the work proceeds. The forms of course have no base but are usually sheeting extending downward for a few feet on each side of the wall. During the pouring operations a force of men is kept busy constantly turning the screw jacks and thus raising the forms, the floor and the screw jacks themselves. Supposing a four foot form is used, not more than four feet of protection is afforded the upper layer of concrete. The work is taken at a slow enough rate to give the concrete at the bottom of the forms a chance to harden before the forms are lifted above it. It will be understood that at the very top of the forms is the freshly poured mixture, while at the bottom is that twelve to twenty-four hours' old.

A scaffold is built around the outside of the elevator suspended a few feet from the forms above. Upon this a force of men are kept at work smoothing off the surface of the concrete from which the forms have just been lifted. When the top of the elevator is reached the job is complete as far as the walls are concerned. This system of moving forms is quite as simple as it is ingenious, there being no difficulties in setting up and transferring forms, while a solid floor is maintained for the workmen. Besides being fireproof, concrete elevators, due to the rapidity with which they may be constructed and the comparatively low cost of materials, are economical. The illustration shows an elevator at Council Bluffs, Iowa, having a capacity of 1,000,000 bushels and costing $600,000.

## A New Electrical Furnace

A NEW type of electric furnace has recently been constructed in Sweden, which possesses several features of interest. It is especially useful as an economical small unit for crucible works and steel foundries. In addition, it may be made suitable for copper smelting, glass melting and for smelting various alloys. The furnace is of the arc type but differs from existing ones: it is cylindrical with closed ends. Two of the electrodes enter the furnace horizontally, one in the center of each end; the third electrode is vertical, entering at the top in the center. The electrical arrangements are such as to throw the arcs down upon the surface of the bath, with which the electrodes are not in contact.

Heating is by radiation of the arcs, but their deflection upon the bath is also of material assistance. The furnace is built with a horizontal cylindrical steel shell, rolling in cradles or tilting round a horizontal diametric axle. In fact its general shape strongly resembles a miniature metal mixer. The furnace is lined with acid, base or neutral material, according to the work for which it is intended. The currents entering at each end through the horizontal electrodes neutralized each other, but the action of the returning current into the central electrode generates a field of force which deflects the arcs downward toward the bath, thus forming the arcs into an inverted arrowhead.

This is the essential factor of the new furnace, which differentiates it from those hitherto used. The points of the electrodes are usually kept six to twelve inches above the surface but they can be adjusted as required. The furnace is adapted for work on cold or liquid metal, and the electrodes can be drawn back while the furnace is being charged. During working there is just enough activity in the bath to form a neutral or reducing atmosphere in the furnace, and the door remains closed until the charge is almost ready. The circular form of the furnace is one of its greatest advantages. The radiating heat from the free-burning arcs is reflected on to the bath from the entire mirror-like incandescent inner surface of the vault. Yet the arcs are at such distance from this roof that the danger of melting is minimized. A sound point in construction is that there is no break between the roof, the side walls and the bottom, all being built together in one curve. To enable the furnace to be relined the shell is in halves, bolted together. The electrodes, of graphite, are held together in a loose fit in water-cooled, insulated phosphor-bronze boxes, those for the horizontal electrodes being adjustable also in the vertical plane. Once the arcs are adjusted it suffices to advance the side electrodes by about one inch per hour.

## Scarcity of Safety-Razor Blades in England

A BIRMINGHAM newspaper points to the scarcity of safety-razor blades, on account of the cessation of their manufacture in the steel centers of England, and the difficulty of obtaining sufficient quantities from foreign countries. The local publication states:

"One of the war's little ironies is that the concentration of the steel output for war work has prevented the Sheffield firms from continuing to produce their small side lines which they were gradually capturing from foreigners. Just at present the average man will be finding that he has the greatest difficulty in purchasing safety-razor blades, or has to pay a much higher price than he anticipated for those he does procure. The facts show that the Sheffield firms are not now making any, and that the foreign supplies are not coming to hand in sufficient quantities to allow the dealers to replenish their stocks. A prominent manufacturer stated that soon the whole of the stocks in the country will be exhausted, and there will be no new ones made to replace them. There is also a prospective shortage of the hollow-ground hand razors, for the ministry of munitions regulations with regard to the purchase of steel at present allow the use of only shell discard steel for this class of work, and the big cutlery firms declare it to be useless for the manufacture of articles which must have a cutting edge.

**At left, the working floor of a concrete elevator under construction, showing jacks for raising the forms. These climb with the progress of work as indicated in the right-hand cut**

# Behind the Cantonments

## Picking the Men for America's Greatest Emergency Engineering Feat

By C. H. Claudy

IT is impossible to say of any one of the thousands of problems which the war has brought to the United States "This is the biggest." But it is certain that from an engineering standpoint the housing of the new army is—was—one of the greatest problems ever tackled by any government.

Sixteen cantonments were required, to cost perhaps $100,000,000, to be built and ready for use in three months. No one knew just what a United States cantonment would be like, no one knew where they were going to be, no one knew who was to build them, or how—but they had to be built!

In a general way it was understood that a cantonment meant a couple of square miles of ground, thousands of wooden buildings, a complete water and sanitary plant, electric light, fire protection, hospitals, garages, workshops, administration buildings, storage warehouses, streets and roads—in other words, that a cantonment was a young city. But because the United States never had built any such emergency cities, little was known about how to go at the job.

This is not a story of the construction of the buildings, the laying of the sewers, the building of the water works, the engineering on the ground, but of the preliminaries. Before a spadeful of earth could be moved, a board sawed or a building started, certain foundations had to be laid.

It was necessary (1) to know *where* the cantonments were to be (2) to know *who* was going to build them (3) to make certain that the work would be done *on time*, maintained at a *satisfactory standard of quality*, at the *lowest possible cost* consistent with speed and quality.

To do this preliminary work the War Department had provided, from its peace basis organization, two competent army officers and two stenographers.

How absurd this was is easily seen when a glance is taken today at the Adams Building, Washington, D. C., where 250 people work under Col. Littel 14 hours a day on the cantonment work, and the Committee on Emergency Construction of Building and Engineering Works of the Council of National Defense, with the services of the best men in the contracting and engineering business in the United States as aids, labor day and night with them.

The first riddle to be solved, under the great problem faced, was the building of the machine to plan and supervise the work. To guess the riddle aright the Emergency Construction Committee grabbed a lot of $25,000-a-year men from the great engineering and construction companies, hired a building, employed clerks, systematized the work, laid out and subdivided the problem and took a good look at it.

All this was necessary, indeed vital, but all preliminary. For the very essence of the whole matter was speed, and speed could only be accomplished by picking the very best firms in the country to do the actual building. There could be no going back, no doing work over, no mistakes rectified. The 16 cantonments had to be built in time, built right, built at the right price. And inasmuch as this work meant spending in a period of three months twice as much money as the Panama Canal cost in one year, it was not possible to experiment.

After the War Department had determined, by careful surveys and deliberate consideration, where the cantonments were to be built, the immediate and vital problem which confronted the machine built up under Col. Littel was: "Who shall do the work?"

But not yet could this question be answered. It is bad enough to tell a contractor to go and build something—details to be given as the work goes on. It is impossible to get any contractor to do anything without a fair and reasonable price agreement in the beginning. So the vital details of contract and payment had to be arranged. With speed and a quality standard for guides, it was obvious that to hunt the lowest price by competitive bids was impossible. A cost plus a percentage basis seemed the only solution. To arrive at what that percentage should be, 100 of the leading contractors of the country were invited to Washington, and the whole matter discussed with them. From these conferences, a definite scale of payments was evolved, and while many contractors showed from their records that it was lower by a large amount than that for which they were accustomed to doing similar work, in no case was there a protest that it was under a living scale. In many cases patriotism rather than the profit, was the deciding factor in a contractor taking the work. Major Starrett puts it "we seemed to hit the lowest edge of attractiveness, and the least possible profit, consistent with that interest which even a patriotic contractor must have to do the work."

If the cost of the work is under $100,000.00 a fee of ten per cent of such cost.

If the cost of the work is over $100,000.00 and under $125,000.00 a fee of $10,000.00.

If the cost of the work is over $125,000.00 and under $250,000.00 a fee of eight per cent of such cost.

If the cost of the work is over $250,000.00 and under $266,666.67 a fee of $20,000.00.

If the cost of the work is over $266,666.67 and under $500,000.00 a fee of seven and one-half per cent of such cost.

If the cost of the work is over $500,000.00 and under $535,714.29 a fee of $37,500.00.

If the cost of the work is over $535,714.29 and under $3,000,000.00 a fee of seven per cent of such cost.

If the cost of the work is over $3,000,000.00 and under $3,500,000.00 a fee of $210,000.00.

If the cost of the work is over $3,500,000.00 a fee of six per cent of such cost.

Provided, however, that the fee upon such part of the cost of the work as is represented by payments to subcontractors shall in each of the above contingencies be five per cent and no more of the amount of such part of the cost.

The cost of materials purchased or furnished by the Contracting Officer for said work, exclusive of all freight charges thereon, shall be included in the cost of the work for the purpose of reckoning such fee to the Contractor, but for no other purpose.

The fee for reconstructing and replacing any of the work destroyed or damaged shall be such percentage of the cost thereof—not exceeding seven per cent—as the contracting officer may determine.

The total fee to the contractor hereunder shall in no event exceed the sum of $250,000.00.

These percentages are based on the assumption that the work will conform in kind with the average run of contracts generally met with in building and construction work.

Where contracting engineers design and lay out the work in addition to performing the contracts, an additional fee of from two and a half to six per cent is allowed according to the amount of engineering or designing involved.

It should be noted that "seven per cent" does not mean seven per cent *profit*. For *cost* does *not* include overhead, and the concensus of opinion of the 100 contractors who discussed the matter was that three and one half per cent was a fair average for overhead, meaning that such a contract involves a profit of but three and one-half per cent.

The question of bonus and forfeiture was promptly decided. There is neither. To have had either would have meant that the Government would have had to supply contractors with definite specifications of what a cantonment should be—so many houses, so many miles of streets, so much grading, etc. In every case changes and alterations have been made as the work progressed, a thing which would not have been possible with a bonus or forfeiture clause in the contract. Moreover, with a contract based on cost *plus*, a bonus offered would merely say to the contractor "Go ahead and spend money as fast as you can. The faster you spend it, the sooner you finish. The sooner you finish, the more bonus you will make, and the more you spend to earn the bonus, the greater amount of money you will earn by your percentage," an obviously foolish arrangement.

Having a form of contract approved by both War Department and contractors, the next step was answering the great question—"Who shall do the building of the cantonments?"

The Committee on Emergency Construction of the Council of National Defense undertook to answer the question, as far as it could be answered by a body with no powers beyond advisory ones. And when understood, the method by which the 16 contractors were picked, is a complete answer to the baseless and often ridiculous charges of graft, favoritism and "influence," made in certain socialistic and pacifist quarters, and marks an epoch in the spending of government money.

The determining—indeed, the only reason for picking any contractor was that he was the known best one for the job. Unquestionably there are others besides those selected who could have done as well—perhaps even better. But to find that out would have meant an experiment. As between two men for any job, which must be done on time, to a standard of quality, at a certain price, does not any sensible authority pick the one who has done similar work?—the one who has a record of achievement, the plant, the material, the men, who is actively engaged in just that kind of work, rather than the other, *perhaps* perfectly competent man, who has done *other* big things but never *this* big thing, who *may* be able to assemble a machine, who very *possibly* can work to time, but who *cannot show it in advance.*"

The method pursued in making the elections is highly interesting, and so scientific, that as Major Starrett (who in private life is Starrett of Starrett and Van Vleck, architects) says: "*We* didn't select the firms—they selected themselves."

The first step was to inquire for some register of construction firms of the United States. The only available list was that of the industrial survey, unavailable for many reasons, chief of which was that it did not contain the information needed by those who would give out these contracts. This information required a thousand details, but in the main, the things the Emergency Construction Committee recommended to Col. Littel and his machine as essentials in contractors were as follows:

A cantonment contractor should demonstrate responsibility by a record of two years of successful experience in the contracting business. He should have performed single contracts at least three-quarters as large as the contract for which he was to be considered, or to a value of $500,000, and his work should have been of a character somewhat similar to the contract under consideration. He should possess, in the opinion of the Committee on Emergency Contracts of Buildings and Engineering Works, a plant suitable for the work, and should submit sufficient proof of a capable organization to conduct the work. He should demonstrate that he can conduct his work under an accounting system satisfactory to the auditors to be appointed by the Government to check and audit his accounts. He should submit a sworn statement of the contracts he has performed during the past two years, together with names and addresses of owners and engineers or architects who had charge of such work and attestations of satisfaction resulting from correspondence with such references should represent at least 25 per cent of the contracts represented in the sworn statement.

To get that part of this information obtainable from others besides the contractor himself a questionnaire was sent to the American Institute of Architects, to the chief engineers of all the railroads, and the chief engineers of all the great industrial corporations. It asked for information regarding contractors and engineers—who they were, what they had, what their reputations were, how much of a plant they had, what their resources were, etc., etc.

Eighteen hundred replies, regarding a thousand firms, was the gratifying response. These thousand firms were separated and classified and from the classification a hundred and a few odd concerns doing a business of $5,000,000 a year were selected. From this list those obviously without experience which would be valuable in cantonment work—dock builders and tunnel builders, for instance—were eliminated. Seventy concerns were then listed geographically—New York showed 25 possible contractors, Des Moines less than six, in some parts of the southwest there were none, etc.

Finally a questionnaire was sent to each contractor, in which he was asked to make an exhaustive statement of his own affairs, his experience, financial responsibility, plant and tools, etc.

Result, a list of the biggest contractors, their own stories of themselves, the opinion in which they were held by the biggest engineers and architects and the men for whom they had done work.

For every contractor there was an envelope, and when it came time to select the man who should build any one cantonment, the man was found, already selected, in the envelope. The selection was based entirely on elimination of the less fit. When only one contractor was left, he was certified and advised to Col. Littel's machine as the one best man for the job.

In most cases the unsuccessful contractors thoroughly understood the method and approved its results, even when they suffered. Occasionally there would be a kick—as when two concerns of equal strength, equal ability, equal records made a choice difficult. Yet it was never really difficult—if one had built many railroad camps as well as many large office buildings, and another concern had never done work outside a city, other things being equal the man who had his plant and resources mobile was the obvious selection.

It is emphatically pointed out that the selections were in no cases invidious comparisons. The contractors *selected themselves*—had been selecting themselves for years by the work they did, the way they did it, the organizations they had built up. The government had concern with only one feature—to pick *the known right man.*

The 16 cantonments are nearly finished. They involve the use of 500,000,000 feet of lumber, one-tenth of America's yearly cut, supplied by 190 lumber mills. From three to four hundred miles of finished surface roads, not including approach roads, form the streets of these emergency cities. Thousands of miles of pipe have been laid, 16 water supplies arranged for, hundreds of carloads of nails driven—it takes a carload of tar paper roofing tacks to hold down the paper roofs in one cantonment! Every cantonment has had to handle at least 5,000 carloads of material—from 50 to 170 carloads a day! These are carloads of *materials*—not Quartermaster Department supplies. From 5,000 to

*(Concluded on page 165)*

# Correspondence

*[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]*

## Glass vs. Paper Milk Bottles

To the Editor of the SCIENTIFIC AMERICAN:

An article on milk bottles from wood pulp, recently published in your magazine, declared that "physicians and health experts have united in condemning the old-fashioned milk bottle as a pernicious germ carrier." We have been unable to find where a single physician or "health expert" of recognized authority in the medical world, has "condemned" the glass milk jar as a common carrier of pathogenic germs.

On the contrary, various tests made by reputable bacteriologists have proven that pathogenic organisms cannot survive the thorough methods of cleansing and disinfection practised in the best dairies. In all modern, sanitary dairies the empty bottles are passed through elaborate manual and mechanical cleansing processes, including scalding, brushing, soaking in hot alkali solution, rinsing and final washing in clean, sterile water. A visit to any dairy certified by the local board of health will prove a revelation of extreme cleanliness and scientific sanitation.

The article asserted that housewives occasionally use the empty bottles as receptacles for vinegar, etc., and that because of the acid traces remaining in the bottle the milk spoils rapidly. This statement would make even a high school student of elementary chemistry smile. A powerful caustic alkali is universally used for soaking returned bottles, and it would require gallons of the strongest mineral acid to so much as neutralize the alkali used in washing even a few cases of bottles.

We particularly call your attention to what appears to be a gross misstatement of facts, and quote from a recent issue of the *Wall Street Journal* commenting on this story:

Every now and again the question is raised as to what is injurious to health from this and that standpoint, and from this and that container. A recent discussion of the problem was published in a magazine which took up the subject of glass milk jars. After describing the superiority of a container not made of glass, it proceeded to denounce the glass milk jar as a menance to health and asserted that Pennsylvania was the first State to condemn it, that Samuel D. Dixon, Commissioner of Pennsylvania, Department of Health, had sounded its death-knell.

In order to verify the above statements a letter was addressed to the Commissioner. His reply, in part, follows:

"In answer to your letter of May 5th, I beg to say that the statement which you quote from the article in the SCIENTIFIC AMERICAN regarding glass milk bottles has been copied and quoted over all parts of the country for the last several months, even though it is false. I do not know where or how it originated."

The fact remains that up to date the most satisfactory container found is that of glass, and particularly is this the case in bottling milk, for the reason that the containers can be examined after washing and before filling and any foreign matter discovered, just as the contents can be judged before pouring.

Glass containers are as yet the only transparent containers on the market, and it seems only reasonable that they should be preferred and considered more than containers which are opaque, or non-transparent, and give off part of their own structure into the contents.

It cannot be denied that paper bottles are extremely unsanitary. They cannot be cleansed by immersion in boiling water, nor can the milk be pasteurized in them. Yet the trend of sanitary legislation is steadily towards the adoption of more effective means of accomplishing both objects. Then what will become of paper milk bottles? It is not possible to give paper bottles a sufficient cleansing to insure the removal of insects and other foreign matter which are likely to get into them in manufacturing, in shipping or in storage. We learned of one case in which cockroaches took up their abode in a stock of paper milk bottles, and were not discovered until the housewives opened their morning's supply of milk. We also learned that the dairy discontinued the use of paper bottles almost immediately.

But there is another objection to their use almost as serious and certain to be promptly noticed by the consumer. We refer to the tendency of grease-coated paper containers to absorb odors. The grease or paraffin necessary to make a paper bottle impervious to moisture will absorb all odors with which it may come in contact, giving the milk an unpleasant taste.

Perfume manufacturers will confirm the fact that primal odors are extracted from flowers by grease, fats or mineral oils, all of which have a strong affinity for them. Paraffin is used in making cold cream for the reason that it retains the perfume wonderfully well. Therefore, any article waxed, greased or oiled, would collect and retain the odor of anything coming in contact with it, or within its range, besides being an excellent collector of germ-laden dust. Paper bottles are usually coated with paraffin, and if paraffin will hold the odor in cold cream it will do the same thing in a paper bottle. Paraffin is no respecter of smells. It makes no difference whether the scent comes from the crushed violet, a filthy freight car, a musty store room, or is wafted to it from the reeking effluvia of a nearby stable. Until the public cultivates an appetite for milk that tastes as though a cat had died in it, they will continue to prefer receiving their daily supply in pure, clean, smell-proof glass.

Poor milk, like any other poor product, can't stand the light of day. It needs to be concealed, but the honest, well-intentioned quality product seeks the widest publicity and offers every opportunity for inspection (prior to purchase) and observation, until entirely consumed. This one fact alone makes the glass bottle industry secure, for there is no other container which combines in such a superlative degree the attractive features of glass. When a dairyman markets his milk in glass the act is self-evident proof of his willingness to court the closest inspection, and this fact favorably inclines us toward its purchase.

The statement that the new paper bottle is cheaper in the long run than the common glass bottle now in use, is the climax of a series of misstatements. The cheapest paper milk bottles cost from 1½ to 2 cents each in large quantities. They can be, and are designed to be, used but once. The cost of the glass milk jar is about four cents and its average life is 26 trips. If paper bottles were used the milk dealer would naturally have to add their cost to the price of the milk, and in that time the consumer would have to pay for 52 cents worth of paper! Then the explosion would come, for the public has had about enough of the H. C. L. to wear its temper down to a very fine edge.

No—the glass milk bottle will not be "eliminated" —not yet.

ROY M. ROSS.

Indianapolis, Ind.

## The Submarine Problem

To the Editor of the SCIENTIFIC AMERICAN:

Please advocate in the SCIENTIFIC AMERICAN the following *feasible* and *inexpensive* (since the boats are *already in commission*) plan for combating the German submarines.

Let *one* port and *one* day in the week be selected, *where* and *when* all boats MUST enter England and upon that day let the mosquito fleets of Great Britain, France and the United States, form a safety-lane, extending, if necessary, 300 miles out to sea from said port, which may be changed weekly, to avoid congestion. Through this lane let *all* ships approach and *no where else!* Then, if German submarines would sink ships, they *must* go there to do it and *fight* for it, which is *what is wanted!*

With bulldog tenacity the English continue to patrol for submarines, just where usually they are not, just as today, in *half* the hotels of England, Scotland, Wales and Ireland, you must light your own candle at the office, in order to go to bed! Guineas, pounds, shillings and pence; even farthings! Great Scott! Three barleycorns 1 inch, 12 inches 1 groat, 3 feet 1 yard and $7\frac{92}{100}$ inches 1 chain! They never will change, if let alone; but since we are in the war, cannot we introduce a modicum of common sense?

Hoping you will treat this matter in your admirable journal.

"AN OLD SALT."

## Barges to Offset the Submarine

To the Editor of the SCIENTIFIC AMERICAN:

Having followed the course of the war through the columns of the SCIENTIFIC AMERICAN and other publications, I wish to express an opinion on the chief subject of discussion at this time, namely means to offset the submarine.

I believe that what we need at this time is strong and aggressive action with the forces now available while we are proceeding with all possible speed in the production of the steel and wooden ships which, I believe, we have decided to build.

I also propose the taking of the available barges such as are in common use on our canals, putting several transverse bulk heads in them so as to make them practically non-sinkable, loading them with the foodstuffs which we are so anxious to get across the Atlantic and when so loaded, sealing over the decks entirely. These barges could then be towed across by ocean-going tugs, the arrangement for towing being in single column connected by the usual towline. One barge could carry the extra coal required by the tug and same could be transferred as needed. The fact that whatever material was moved in this way would be in addition to that carried by other means would offset the disadvantage of the slowness of passage, which would very likely be 30 days.

The chief advantage of this method, however, lies in the fact that, as torpedoes are set to travel about eight feet below the surface, it would be impossible for a submarine to sink one of the barges even if the captain in charge should think it worth while to use a very expensive torpedo for the destruction of the goods contained in such a small unit. It would also be very difficult to hit one of these comparatively short boats even should the depth of draft have made this possible. The tug also offers an extremely difficult mark owing to its small size.

This group of barges should be accompanied by an armed boat of the chaser type. The tug should also carry a gun crew, and should a submarine appear on the surface, one of these boats could destroy her by gun-fire.

There must be on the Atlantic coast several hundred barges that could be quickly and inexpensively put in shape for this purpose.

C. F. BENEDICT.

*It would be impossible to hold such a tow together in heavy weather. It would be scattered.*—ED.]

## The Fourth Dimension

To the Editor of the SCIENTIFIC AMERICAN:

I wonder whether you could not find space in your pages to request those of your readers whose interest in the Fourth Dimension is such that they would care to do so, to help a British officer to while away some of his idle hours by corresponding with him upon the subject.

LIEUT.-COL. E. G. START.

Address: Mesopotamia Expeditionary Force.

## A German Business Trick

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of 14th April, 1917, page 373, Mr. F. Caoul is making critical comments on Mr. Dawson's article on the "German Grain Supply."

He is *nearly* right, but not altogether. The true reason of the German export of rye into Russia is not at all any surplus of it, but in reality this is the high "Export-Prämie" paid by Germany to every exporter of rye. This premium is high enough to buy rye in Russia, say at 180, to import it into Germany, and to resell it to Russia for perhaps 175, because the exporter gets the "Export-Prämie," high enough to leave a favorable balance.

These premiums have run up during many years to hundreds of millions, all paid by the German taxpayers, in spite of all protests. Before the war, I have, as a Russian, supplied ample information about this matter, and Russian business generally, to the *German Journal of National Economy.*

W. EWALD.

Porto Alegre, Brazil.

## Composite Ship Construction

To the Editor of the SCIENTIFIC AMERICAN:

The suggestion of your correspondent, Mr. James M. Welch, to adopt steel frames in the construction of wooden vessels, as described in your issue of the 21st. July is commendable. This system of fabrication is, of course, that which is well-known as "composite" construction, and is really anterior to that of purely iron or steel construction. The old "Great Britain," designed by Brunel, in the year 1840, was in a degree composite as she had a large oak keel, and her top-chord was constructed entirely of wood, as iron decks had not yet been developed. Even her machinery was partly composite, her screw-shaft being geared up—not down as is usual today—with gear wheels fitted with wooden cogs, or teeth, to augment the revolutions of the screw propeller.

Fifty years ago, composite construction was popular in the old country, when wood became scarce. Moreover, the wood planking was readily susceptible of "coppering," to prevent fouling, during a long voyage. A few months ago, I proposed that steel frames be adopted for our emergency ships, all of which frames, vertical and horizontal, should be absolutely straight and of one length, connected to a quadrantal bilge futtock, the deck beams also being straight and of one length, for about 60 or 70 per cent of the length over the midships body, which, in fact, was to be prismatic. This was the complement of my design for wooden emergency vessels to save hand labor in cutting out bilge futtocks of large radius. The vessel would have no sheer for 60 or 70 per cent of the midships body, all of which would be made from the same mold. The idea of a sheerless ship, is not new; the "Great Eastern," the most efficient and economically designed *hull* that ever floated, was without sheer. Several steamers built under my superintendence some years ago were sheerless, and they have given every satisfaction up to date.

It would not be practicable to make the keel, stem and post of a composite ship, of iron, as a strong and water-tight connection of the wood plank could not be thus effected. These elements are made of hard wood, preferably oak.

JOSEPH R. OLDHAM.

Cleveland, O.

# The Submarine Problem—XIII

## Marine Camouflage and Its Relation to the U-Boat Campaign

CAMOUFLAGE—that new art born on the battle-fields of Europe—appears to be more and more a factor in the U-boat campaign. True, it is not a factor of the first importance as so far developed; but nevertheless its application by both ourselves and the enemy is having an important bearing on the success of either side. And it is particularly in the future when the marine branch of this art will have been developed to a higher degree, that interesting results may be looked to.

In military parlance the new word, camouflage, signifies the art of deception as applied to military operations in order to baffle or confuse the enemy. It takes a wide variety of forms, depending upon the object treated. In its simplest form camouflage consists of a little straw covering a machine-gun emplacement, so that it cannot be detected by enemy observers but a short distance away, while in its more complex application it may be a life-sized painting of a village street, behind which a battery of field guns operates with almost complete immunity from retaliatory fire.

Bringing the new art to the high seas, it appears that much can be done with camouflage; indeed, this branch should offer as wide a field for skill and inventiveness as do operations on land. Aside from the painting of surface craft in a dead gray, so as to be less conspicuous at a distance—an elemental but crude form of camouflage, it appears that the Germans were the first to apply the lessons of military warfare as regards the deception of the enemy. In their earlier attempts they applied various designs to the painting of the U-boats to make them less conspicuous and of late they have extended marine camouflage to include decoys of different kinds.

A favorite ruse of the German U-boats is to make use of neutral vessels as screens in order to get unsuspecting prey within ready torpedo range. Time and again reports have told of nefarious acts of this kind, when merchantmen have suddenly found themselves confronted by a big U-boat emerging from behind a neutral ship, the latter being forced to aid the Germans in their work. At other times the U-boats have sought to hide behind sinking vessels which had sent out calls of distress, coming out to shell or torpedo other ships arriving on the scene to rescue the survivors.

By bitter experience our allies have learned only too well to avoid such crude subterfuges as these and as a general thing merchantmen now give vessels of all kinds in the danger zone a wide berth unless they are certain that there is no ruse being practiced.

Somewhat on a higher plane, as far as ingenuity is concerned, is the method employed by a U-boat several weeks ago. An American steamer reaching a British port reported having come across a row-boat which served as a decoy for a lurking submarine. It appears that the American vessel was zigzagging along at 18 knots, some 90 miles off the Irish coast. It was a trifle after 8 o'clock, and because of the bright moonlight every object could readily be seen. Suddenly, the lookout man in the crow's nest at the foretopmast head called out that a boat was in sight, four points away on the starboard bow.

The captain and his officers on the bridge looked through their glasses and made out a light object which proved to be a ship's life-boat of an extra large size, bobbing up and down on the waves. The liner soon overhauled the boat only to learn that there were no occupants. Just then, when the liner was some 600 yards away the crew of the six-inch gun aft saw a torpedo pass from port to starboard within five feet of the rudder. Immediately the captain swung the liner hard over to starboard, and at the same time the gunners aft fired a shot at the submarine which could then be seen afloat on the port quarter, about 550 yards away. Shots were fired from both guns of the liner, and some of the shells fell close to the U-boat with questionable results. At any rate, the liner succeeded in escaping from this ambush.

Using their wireless masts as supports for sails, German U-boats have on occasion disguised themselves as harmless sailing vessels luring freighters to their doom. It is said that the sails are so cleverly arranged that the victim comes within shell range long before the true nature of the strange craft is discovered.

There are so many ways in which the periscope can be camouflaged that it is safe to say that many a harmless looking flask, a piece of drift wood, or a mass of debris serves as a covering for the "eye" of a submarine laying in wait for victims. This, together with the fact that periscopes of a telescopic design are being used, is making it increasingly difficult to detect the presence of U-boats merely by their periscopes.

So far so good. But marine camouflage is a game at which two can play; and this is one thing in which the Allies and ourselves have not been slow in copying the enemy's methods and even improving on them. While the sub-sea craft lends itself to disguise more readily and more effectively than the larger surface craft, much can be done with the latter in the way of making superstructures less conspicuous and being liberal—and skilled—with paints of various shades and hues.

Copyrighted by Munn & Co., Inc.

**Disguised as a sailing vessel, U-boats have lured merchantmen to within ready shelling and torpedoing distance**

Copyrighted by Munn & Co., Inc

**Using a row-boat as a cover for its periscope, a U-boat nearly succeeded in torpedoing an American steamer 600 yards away**

At present the camouflaging of steamers has advanced little beyond the deceptive coat-of-paint stage, but even this is said to be most effective. Of the many methods either tried out or suggested, two are most promising, namely, the Brush system and the Mackay system. In the former the camouflage artist paints out all shadows and softens or destroys all outlines, and the entire superstructure is painted a sky blue or some other color which blends with the horizon. In this manner, if the work is carried out with consummate skill and patience, the vessel is indistinct even a short distance away, especially if the submarine commander is making his observations through a periscope. In the latter or Mackay system the camouflage takes the form of a leopard-spot design, so that all outlines are broken up by the blotchy coat of paint, and parts of the vessel are even painted with wavy lines so as to match with the surrounding water.

Clever feats of camouflage enable vessels to appear much shorter than they are, tending to deceive the U-boat marksman to a greater or less degree. In the same class is the painting of fake bow waves which give the vessel the appearance of traveling along at a high rate of speed when it may be considerably slowed down. Particularly is the latter scheme invaluable when the U-boat commander, estimating the intended victim's speed is fooled into believing that she is a fast boat; for when the torpedo is fired it is very likely to pass considerably in front of the lumbering steamer.

As one more means of defeating the U-boat campaign, camouflage should be carefully studied with a view to developing still more effective methods. Also should the surface craft be made less conspicuous by the use of anthracite coal while traveling through the danger zone, and by reducing the size of such superstructure as masts, derricks and funnels to the greatest degree possible consistent with safe navigation. If necessary forced draft should be used on the fires making it practical to dispense with tall funnels; for a submarine generally spots its victim through a priscope, and the lower a craft rests on the water the better its chances of not being detected, especially if it leaves no tell-tale wake of smoke behind it.

Again we repeat that the quickest and surest way of winning the submarine war is to confine the German undersea raiders within a restricted area such as the North Sea. A bomb curtain extending from the coast of Scotland to the coast of Norway is possible of construction, with our engineering knowledge and facilities, and despite the numerous military, political and technical obstacles to be overcome, it could be undertaken right now with every promise of successful consummation. Then, and then only, would the German U-boats be cleared from the high seas.

In the meantime the problem is to hunt out the U-boats on the one hand, and to escape their depredations on the other. And while this state of things obtains it will be well for the artist—for this phase is strictly within his sphere—to devote some time to a study of the problem with a view to evolving better means of camouflage.

## Carburizing Iron by Gas

THE efficiency of cementing or hardening iron by gas under pressure, instead of the modern methods has been tried by F. C. Langenberg of Harvard University, Cambridge, Mass. He reports in part:

A special form of furnace was used, combining all the requirements of a vacuum and pressure furnace in a single unit. The detailed description of this furnace should be of value to other investigators, for the general arrangements make it applicable to a much wider range of work than the particular investigations of the author.

In the experiments the material subjected to carburization was ingot iron of the following percentage composition: Carbon, 0.01; silicon, 0.002; sulfur, 0.002; phosphorus, 0.003 per cent, with a trace of manganese. The gases used were illuminating gas and acetylene. The samples of iron to be cemented were turned down in a precision lathe to a uniform diameter (within 0.001 in.) and were approximately 0.45 inch in diameter and 0.85 inch in length. Every sample was accurately weighed and measured before and after treatment.

Twelve series of experiments were carried out, and the author concludes that the gamma-beta points seem to mark a sharp break in the carburization curves for both town gas and acetylene; no carburization ensued below 720 degrees C.; and the effect of pressure on the degree of carburization with the gaseous systems found in illuminating gas was different at different temperatures, the various curves indicating that after a certain pressure is reached further increase of pressure will not cause additional absorption of carbon by the iron.

# Eliminating Disease from the Casualty List

## The Manufacture of Typhoid Vaccine by the French Service

THE presence of the American troops at the battle front in western Europe naturally arouses an interest in many problems connected with the war, outside of actual fighting. By no means the least of these is the service of hygiene and sanitation, and in view of the remarkable record that has been made in the United States Army in protecting the health of the soldiers against such diseases as typhoid, by a system of compulsory vaccination, the people of America can look forward with confidence that there will be no repetition of the experiences of former wars, in which preventable diseases took a greater toll of the soldiers engaged than the bullets of the battlefield.

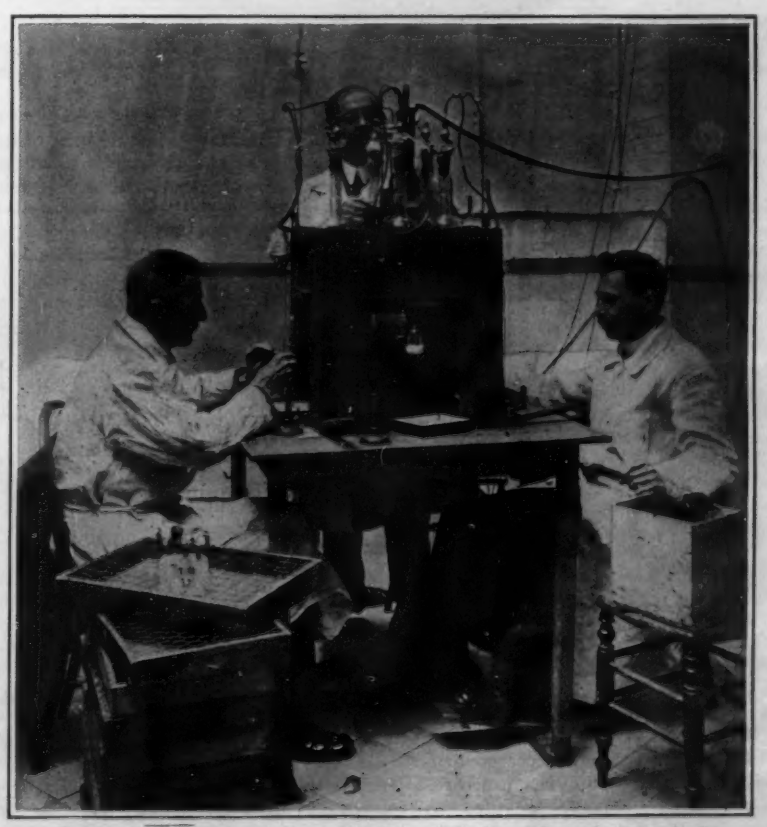
In the French and other foreign services during the present war, preventive medicine has figured to a far greater extent than ever previously, and the manufacture of the anti-typhoid vaccine, carried on in the French Army laboratory, has become an important industry. At the same time, there is maintained the bacteriological control and technique demanded by the best scientific practice, and the results of the administration of the vaccine have been in line with prevailing experience under conditions of peace.

Before considering the process employed in this laboratory, in making the anti-typhoid vaccine, it might be advantageous to recall the principle on which this form of vaccino-therapy is based. It dates back to the fundamental discovery of Pasteur that the inoculation of a subject with attenuated toxins produced by artificially cultivated pathogenic bacteria may lead to the formation in his system of anti-toxins immunizing him against the attacks of these same toxins. Thus a vaccine is a virus endowed with feeble activities, harmless to the individual in whom it is injected, but capable of conferring immunity upon him. A vaccine differs from a serum, in that it merely stimulates the human organism to react against the activities of a certain class of bacteria, and does not contain wholly formed anti-toxins, which have been artificially developed in an animal.

The first to develop the idea of vaccinating against typhoid fever were two French physicians, Chantemesse and Widal, who carried on a series of experiments from 1888 to 1892. They inoculated with bacilli that had been killed by heat, but unfortunately they employed high temperatures to 120° C (248° F.). As the Anti-typhoid Committee of London stated as early as 1902, the heating of a sterilized culture to a temperature above 65° serves to weaken considerably the curative properties of a vaccine thus obtained. The use of bacilli living, but attenuated in virulence, was suggested even earlier by Ferran, and then Haffkine, as a protection against cholera and the plague. Pfeiffer, in Germany, showed the possibilities of employing dead microbes; and in 1896 Almroth Wright, in England, as a result of previous work, proposed as a typhoid vaccine a microbe culture, heated to 56° or 58° C. (*i.e.* 133° F.). About the same time Aldo Castellani, in Italy, professor in the University of Naples, recommended the use of a vaccine containing living bacilli, but attenuated by exposure to a temperature of only 50° C. (122°F.). All of these attempts had various defects; but experiment continued. Wassermann attempted in 1904 to kill the microbes by the use of chloroform, and three years later this method was used for the manufacture of anti-typhoid vaccine by surgeons in the British Army. In France, M. Vincent, professor in the military school of the Val-de-Grace, made a series of comparative tests on various solvents for the bacteria. He finally discarded all containing antiseptics, and successfully prepared several kinds of vaccines known as polyvalents.

**Vaccinating French soldiers against typhoid. Note the iodine stain on each bared shoulder**

**Counting the number of bacilli per liter to insure that the vaccine be of standard strength**



**Putting the vaccine up in hermetically sealed glass tubes whose content must be exactly right**

The anti-typhoid vaccine of Vincent was straightway developed and extensively used in France, especially in the army. It was employed from the beginning of the Moroccan campaign (1912), and served to keep the French troops in excellent hygienic condition. It was also used by Greece during the Balkan wars, and by Italy in its Libyan expedition. It was the Vincent vaccine which the Health Service adopted when the law of 1914 rendered anti-typhoid vaccination obligatory in the French Army.

The technique followed in the anti-typhoid laboratory of the French Army has been developed both on the scientific and the administrative side, and the delicate and numerous manipulations involved have been carried out there since the beginning of the war by an enthusiastic and competent personnel. On the staff are included physicians and bacteriologists, Red Cross nurses, University professors, soldiers of the auxiliary service, and volunteer men and women workers from the ranks of society.

The first process is placing the bacilli on the gelatine which has been run into shallow dishes, previously sterilized in the autoclave. The operator by means of a pipette, which is connected with his mouth by a rubber tube, takes the desired quantity of the virus from tubes placed on the table before which he is seated, and introduces it into a culture flask, which he stops with a tampon of cotton that has been passed through the flame of a gas jet. Ten varieties of typhoid bacilli, indigenous and exotic, are used in the preparation of the anti-typhoid vaccines. Next the flasks containing the bacilli are carried to an incubator maintained at 38° C. (100° F.) and are left there for 19 hours; after which a sterilized medium is added to this microbe culture, and then pure ether is added to the emulsion of typhoid bacilli thus produced. The mixture after being shaken for some seconds, is put aside to stand for five hours. The lower portion, which is drawn off, contains all the bacilli and soluble immunizing substances. On account of its lightness, the other rises to the top of the drawn-off liquid which, with the addition of a certain quantity of salt water, constitutes the definitive vaccine.

The number of bacteria contained in each liter, is now carefully determined and sterility verified. When the flasks containing the vaccine have been thus tested, a siphon specially devised by Professor Vincent is employed for the aseptic distribution of the vaccine in glass capsules of 2, 5, 10, or 20 cubic centimeters. After being filled, these are sealed by blowpipe flame, and labels bearing the date of preparation are pasted on the glass. These glass capsules are kept in refrigerators, and maintained under such conditions that their active properties persist for three months.

Such are the principal phases of the making of anti-typhoid vaccine, but in a large government laboratory there are many mechanical appliances, interesting and important, as well as instruments and ingenious processes which it was found necessary to devise to increase production to the required amount. The laboratory of the Val-de-Grace in fact, through the coöperation of a hundred or more faithful men and women, many of whom at times have worked to 11 o'clock at night, for two years has succeeded in supplying the thousands of vaccine doses necessary to immunize the soldiers of the Allied armies.

Among the more important and useful devices are the heat sterilizers and the apparatus employed for the distribution of the vaccine in the glass capsules, both of them contrived and used according to the direction of Professor Vincent. In the sterilizers used for all the glassware, the gases of combustion pass into the heat

*(Continued on page 163)*

# The Heavens In September, 1917

## The Finest Objects in the Sky

By Prof. Henry Norris Russell, Ph.D.

A RECENT article by Prof. M. H. Pickering, entitled "The Sixty Finest Objects in the Sky" may well serve, as it were, as the text for our present discussion. The full list—which may be found in *Popular Astronomy* for last February—is of great value to the amateur, and not less useful to the professional astronomer who may be entertaining visitors at his observatory, for it is the result of a careful comparison, with the same telescope, of the most interesting objects for the star-gazer. But it is not our present purpose to discuss the list as a whole—it will be more profitable to select from it those heavenly bodies which are conveniently observable in the present month, and give directions such that the amateur, equipped with a small telescope, may find them.

Most atronomers would agree with Professor Pickering's verdict that the most attractive of all celestial objects, especially with a small telescope, is the Moon, when not too near the full. But it is hardly necessary to give directions for finding this! Next come the brighter planets: but they are unfavorably placed this month. Venus low in the west of the sunset, Jupiter, rising about 10 P. M. and too low to see well till after midnight, and Saturn invisible until about 2 A. M. We must evidently occupy our telescopes principally with the permanent features of the sky, stars, star-clusters and nebulæ, and here it may be well to warn the novice not to look at nebulæ, or at any but the brightest clusters, on a moonlight night, for the illumination of the sky on such a night drowns their feeble light entirely.

Bright stars are always interesting to the visitor who is taking his first peep through a telescope, and none in sight affords so fine a spectacle as Vega, which is notable not only for the intensity and pure whiteness of its light, but because it lies in a fine Milky Way "field" sprinkled richly with faint stars. One of these, though in reality far, far beyond the bright star, is so nearly in line with it as to appear like a fairly close companion in a small telescope. It is of the tenth magnitude, ten thousand times fainter than its dazzling neighbor, so that it may not be seen at first glance, though any telescope of more than 3 inches in aperture should show it. Of these double stars, which are really neighbors in space, and are moving about one another in orbits, there are so many that our only problem is to pick out the best ones to look at.

A very beautiful pair is $\beta$ Cygni, at the foot of the cross of Cygnus, not far from Vega, and shown on our map. Though a very wide pair, the components being thereby seconds of arc apart, and separable with a powerful binocular, it is notable for the finely contrasted colors, the brighter star being orange, and the fainter one white, though from contrast with the other it looks blue, to most people.

Another fine double with contrasted colors is Gamma ($\gamma$) Andromedae, found very easily with the aid of the map. Here the components are closer, 10 seconds apart, but again the bright star is yellow, and the fainter one blue by contrast. This fainter star is a very close double, but only a powerful instrument will "resolve" it.

Not far away, in the eastern sky is the first star ever discovered, Gamma Arietis, the faintest of the three which make up the well known "head of Aries". In this case both stars are white, and they are so nearly equal in brightness that it is impossible for the eye to tell which exceeds the other. It is of historic interest, as being one of the first stars recorded as double, having been noticed by Horton in 1664.

Returning to the western sky, we find a very fine system in $\varepsilon$ Lyrae, the northernmost of the two small stars close to Vega. Keen-eyed people can see this star double without optical aid, the distance of the components being 207 seconds, or about one-tenth of the apparent diameter of the Moon. Even a field-glass will show the stars widely separated, and with a telescope they appear very far apart. More careful looking shows that each of the two stars is itself double, but a magnifying power of at least 100, on a telescope of not less than three-inch aperture, is needed to show this to the novice.

Having looked at these double stars we may find it interesting to turn to a star of unusually conspicuous color. All the strongly colored stars are red, and all the very red stars are faint. The brightest object of this sort now in view is on the constellation Pisces, and is known as 19 Piscium. To find it, look half way between the bright stars $\alpha$ Pegasi and $\iota$ Ceti, both of which are shown on the map, and you will find a group of seven faint stars forming a rather regular oval figure. The star we are seeking is the lower one of the two at the left-hand side of the oval, as it now appears in the sky. It is distinctly visible to the naked eye, but is too faint to show any color. The larger the telescope, the stronger will its color appear. There can now be little, if any doubt that this star, like others of extreme redness, owes its color to a relatively low temperature.

Another star of unusual interest is the variable Omicron Ceti, often known as Mira, which is plainly marked on our map. For about half the time this star is invisible to the naked eye, but at intervals of about eleven months it becomes easily visible for two or three months. It usually does not get much above the fourth magnitude, that is, it is easily visible to the unaided eye, but is not conspicuous, but once in a while it rises to the second magnitude, and is the brightest star in all that part of the sky. At the present time the star is increasing rapidly in brightness, and early in September it should become visible to the naked eye, though it will not reach its maximum brightness till near the end of the year.


At 11 o'clock: Sept. 6.
At 10½ o'clock: Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

NIGHT SKY: SEPTEMBER AND OCTOBER

Turning now to star-clusters, we have two of the finest objects in the sky in sight. One of them lies about halfway between the constellations Perseus and Cassiopeia and is conspicuous on any dark night as a bright spot in the Milky Way. With even a small telescope, this spot is revealed as a magnificent double cluster of stars hundreds of them, invisible to the unaided eye but easily seen with the telescope.

A more difficult, but even more remarkable object, is the great globular cluster in Hercules. This lies on the line joining the stars $\zeta$ and $\eta$ Hercules, shown on the map, and about one-third of the way from the latter towards the former. It is just visible to the naked eye as a speck of light. A field-glass, or better a small telescope, reveals it as a large, ill-defined ball of light, brighter at the center. With a larger instrument, of 6 or 8 inch aperture, it becomes possible to see that countless tiny stars are sprinkled all over this luminous area. But the true grandeur of the cluster is brought out only with the greatest telescopes, which show a blaze of light composed of thousands of separate stars, the number, according to estimates based on photographs of long exposure, being fully thirty thousand.

Finally, we may find two of the most interesting nebulæ in the sky. One in Andromeda, is marked on our map, near the star $\beta$. It is conspicuous to the naked eye, and a very pretty object in a small telescope. With a large instrument it is somewhat disappointing for only the central portions can be seen (since it is far larger than the field of view) and these show little detail. Photography alone brings out the wonderful spiral structure of the outer portions, which is familiar to most people interested in astronomy, from the many pictures which have been published. But no one has ever seen these spiral arms in their full development, nor is anyone likely to see them unless some means should be devised for making our eyes as sensitive to faint light, at one glance, as a photographic plate is after many hours' exposure.

Finally, let us turn back to Lyra, and, on the line between the stars $\beta$ and $\gamma$, the two nearly equal ones, close together, to the left of Vega, we will find if we look closely, a faint circular spot of light, which more careful watching will show to be a ring, the inner region, though faintly luminous, being not nearly as bright as the edge. This is the famous Ring Nebula in Lyra. Spectroscopic observation proves that it is a mass of luminous gas, unlike the nebula in Andromeda, which appears to be a vast cluster of stars. No one knows just how far off this nebula is, but its distance must be at least a hundred light years, which means that its diameter cannot be less than forty times that of Neptune's orbit.

Many of the most prominent constallations have already been mentioned in our telescopic sweep over the sky. Cygnus is high in the west, with Lyra, Hercules and Corona below. Draco and Ursa Minor are in the northwest, with the Great Dipper below, on the horizon. Auriga is rising in the northeast, with Perseus and Cassiopeia above it. Pegasus is high on the southeast, with Pisces and Cetus below, and Andromeda on the left, below which are Aries and Taurus (rising). The bright star low down in the south is Fomalhaut. Aquarius and Capricornus occupy the dull region higher up. Aquila is well up in the southwest, and Sagittarius is setting below.

### The Planets

Mercury is an evening star at the beginning of September, but is deep in the twilight, setting about 7 P. M. On the 18th he passes through conjunction with the Sun, and becomes a morning star, At the end of the month he rises at 5.30 A. M., and is easily seen before day break

Venus is an evening star, setting about 7.45 P. M. on the 1st, and 7.15 on the 30th, her motion southward more than losing what she gains by being farther from the Sun. She is conspicuous in the twilight.

Mars is a morning star in Gemini and Cancer, rising at 1.30 A. M. in the middle of the month. He is not far west of Saturn, and overtakes him on October 1st, the two planets being less than a degree apart.

Jupiter is in Taurus, and rises at 9.45 in the middle of the month, so that he is the brightest object in the later evening sky.

Saturn is in Cancer, near Mars, and rises at 2.40 A. M., on the 1st and 1 A. M. on the 30th.

Uranus is in Capricornus, as described last month, and comes to the meridian at about 10 P. M. Neptune is in Cancer and is in conjunction with Mars on the 22d, being 1° 18′ south of the brighter planet.

The Moon is full at 7 A. M. on September 1st, in her last quarter at 2 A. M. on the 8th, new at 5 A. M. on the 16th, in her first quarter at 1 A. M. on the 24th, and full again at 4 P. M. on the 30th. She is nearest the Earth on the 1st and 29th, and farthest away on the 14th. She passes near Uranus on the 1st, Jupiter on the 7th, Mars and Neptune on the 11th, Saturn on the 12th. Mercury on the 16th, Venus on the 19th, and Uranus again on the 27th.

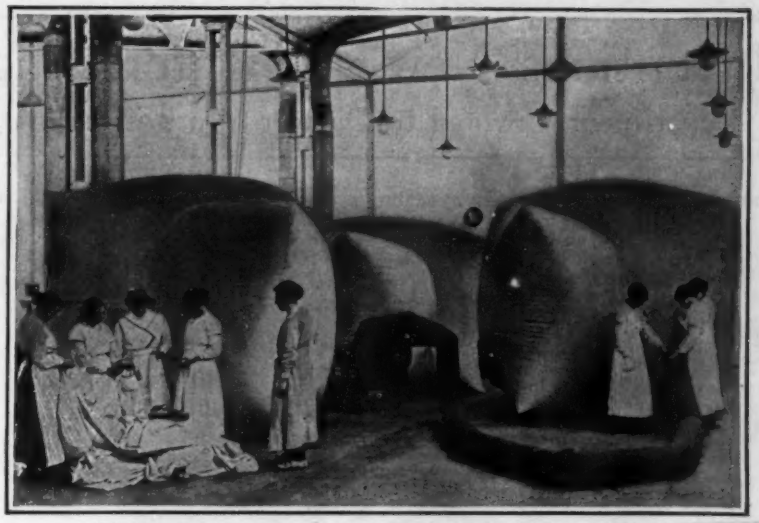
At 10 A. M. on September 23d the Sun crosses the celestial equator on his southward journey, and, in almanac language "Autumn commences."

Princeton University Observatory,
August 20, 1917.

**The drain of the war** upon English labor has reached such a stage that in certain lines of business no men between the ages of eighteen and sixty-one may be employed. Women have taken the places of men with the understanding that after the war the men will be reinstated in their old positions.

### Making Target Balloons to be Shot Down by Aerial Marksmen

IN training aerial marksmen to shoot straight the British government makes use of small target balloons which are manufactured in large quantities. In the accompanying illustration may be seen a number of women making double target balloons in a typical factory. These balloons are made in two sections, so that when one section is punctured by a successful shot from the gun of the aerial apprentice the balloon remains in the air, permitting a second hit, and thus doubling the life of the target. An electric air pump is being used to fill the balloons.

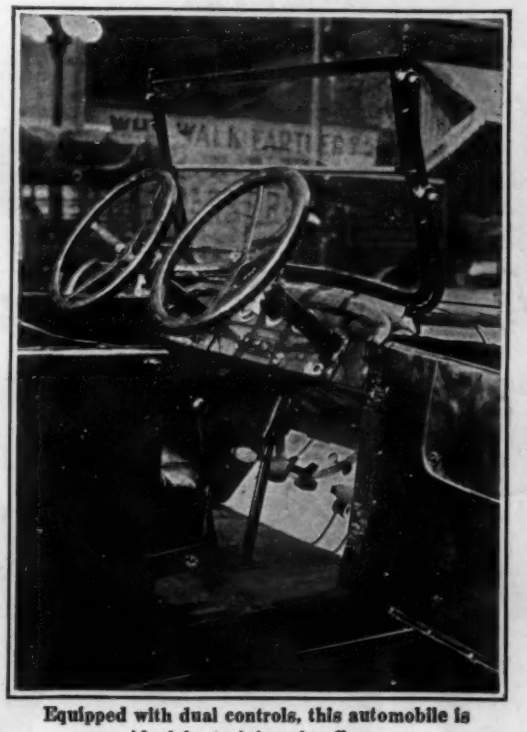


**Blowing up the target balloons used by the British in training apprentice aerial marksmen**

### Training Women Chauffeurs with a Dual-Control Car

IN solving the problem of training a large number of women chauffeurs, the Red Cross Association recently made use of a double-drive automobile, and it is said that the experiment proved most successful. This innovation in the schooling of new drivers is said to overcome the fear and nervousness of the pupils, and hence the liability of accident during their course of training.

In the accompanying illustration appears the double-drive car which was employed in training the Red Cross drivers. The controls are duplicated throughout; there are two sets of clutch and brake pedals, two accelerators, and two steering wheels which are operated as one through the medium of a connecting chain, as shown. The change-gear and emergency brake levers, being placed in the center, are not duplicated. Much in the same manner as the dual-control training aeroplanes used at aviation schools, the chauffeur aspirant has but to follow the motions of the teacher, gradually taking over the entire control of the car. Meanwhile the teacher, with a set of controls at his command, can rectify any mistakes the pupil may make.



**Equipped with dual controls, this automobile is ideal for training chauffeurs**

### Surface Combustion

IN burning an explosive mixture of gas and air it is an essential condition that the mixture shall issue from the nozzle at a speed greater than the velocity of flame propagation in the mixture, otherwise the flame will spread into the nozzle and cause an explosion in the pipes and mixing chamber. On the other hand, if the mixture issues at such a speed as to preclude the possibility of backfiring, it will be traveling too fast to allow of its burning at the orifice, and the flame will be a scattered flare hovering about the place where the stream has slowed down to about the speed of flame propagation.

This latter condition cannot be tolerated in an enclosed combustion chamber, such as a boiler or metallurgical furnace, on account of the danger of explosions in the furnace itself, and a choice of two courses is therefore presented—either to bring the gas and air to a duplex nozzle in separate pipes, or to provide a means of checking the fast issuing stream of gas and air by placing an incandescent surface in the line of flow, and thus compelling the mixture to burn at that place. The first course falls short of the ideal for many reasons, and much attention has been given of late to the solution of the problem along the lines of the second course.

One method, that associated with the researches of Prof. Bone, is to force the mixture through a porous mass of refractory material in and upon which it burns, bringing the upper layer of the material to a state of high incandescence. Another method is to project the jet from the nozzle upon a bed of loose lumps of refractory material, so that the velocity is suitably reduced by this bed, and combustion takes place at or near its incandescent surface. In the latest developments of this second method, the mixture is directed from an orifice in front of the furnace in a downward direction, at an angle of about forty-five degrees, upon a bed of loose lumps of alundum. The bed slopes upward at an angle of about thirty degrees away from the furnace front, and the burning gases are thereby deflected upward again into the body of the furnace. The mixture of gas and air is supplied in the theoretically correct proportions for complete combustion, and consequently no excess or secondary air is required.

A high degree of efficiency is claimed for this type of surface combustion as compared with standard blast-burners. In lead melting the surface-combustion furnace showed a saving of 33 per cent over an ordinary furnace. A comparative test between two annealing furnaces showed a saving of 28 per cent for surface combustion. The process is said to be an ideal one for burning any kind of gas, but to have especial advantages in the burning of gas under boilers. The water-pipe type of boiler is, probably, the one best adapted to it. By placing the tubes close to the bed advantage is taken of the high temperature and direct radiation without danger of incomplete combustion. Present experiments indicate that the only limit to the amount of gas that may be burned in a given space is the ability of the refractory materials in the furnace to withstand the temperature. It is found that firebrick readily fuses in a properly adjusted surface—combustion furnace of this type—hence the use of alundum with its much lighter degree of refractoriness.

### The Current Supplement

AN old subject is considered from an entirely new and fresh point of view in the unusually interesting article on *Mimicry in Animals* in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2174 for September 1st. *The Use of Titanium in Steel Castings* tells how this material is best added, and its efficiency as a substitute for manganese. A particularly valuable technical paper, but one that is fully within the comprehension of every reader, is *Metallurgical Processes in the Foundry*, and it is illustrated by many special photographs. Another paper of interest to many is *The Radiation of the Stars*. Our smooth city streets are so familiar to all that little thought is given to the material of which the surface is composed, or where it comes from. The article on *Asphalt* contains much general information on the subject, and is illustrated by a number of excellent pictures. *The Projection of Light* contains an unusual discussion of the subject of brightness, and various methods of projection, and gives a simple method of considering the important factors in light projection. *The Use of Mean Sea-Level as the Datum for Elevations* discusses an important problem of importance to every engineer engaged in public work. Other articles of value are *A Qualitative Determination of the Reflection Coefficients of Some Metals in the Schumann Region; A Kinetic Hypothesis to Explain the Function of Electrons in the Chemical Combination of Atoms; Meteorology and Aviation* and *Petroleum in Assam*.

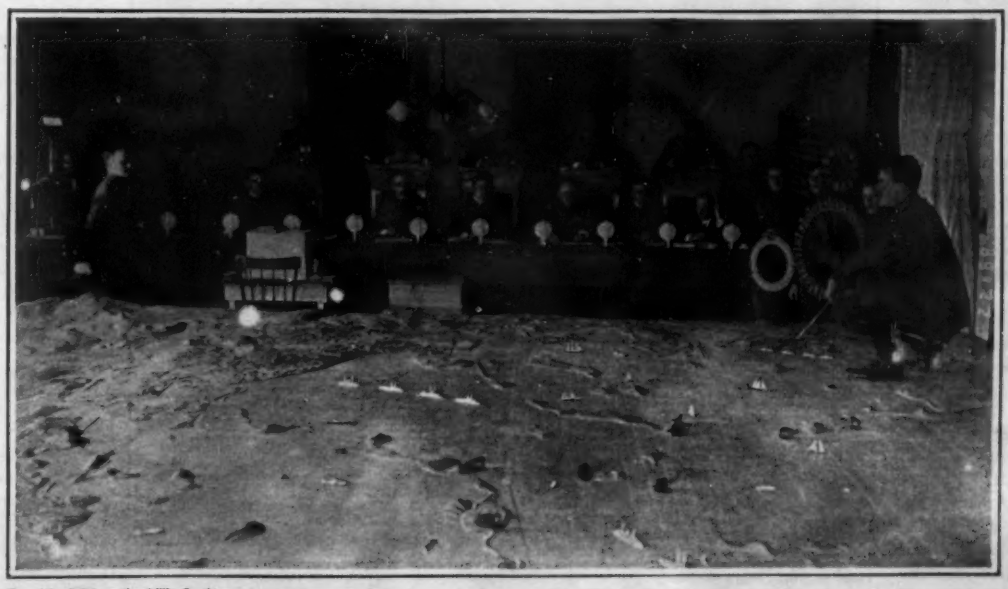
### Hail in the United States

AS compared with certain European countries, the United States has not collected extensive statistics of hailstorms. Prof. A. J. Henry, who discusses this subject in a recent number of the *Monthly Weather Review*, states that, as hail is a highly localized phenomenon, the collection of accurate records would require the existence of an immense number of observing stations. In a state the size of Iowa, for instance, about 14,000 stations would be required. The companies engaged in hail insurance have formed certain ideas regarding the geographical distribution of the phenomenon, based on their own experience, and they adjust their premiums accordingly; but more definite information is desired concerning both the frequency of hailstorms and the amount of damage wrought by them in various parts of the country. Prof. Henry, in the article mentioned, presents statistics of frequency based only on the records of the regular stations of the Weather Bureau, about 200 in number for the period 1915-16, and corresponding charts for the four seasons and the year. Of the stations included, Cheyenne, Wyo., has the greatest annual number of hailstorms, viz, an average of 9.4 per annum.

### Teaching Our Coast Artillery Officers the War Game

WITH little ships which are moved about on a large relief map, and which would at once be the joy and pride of any youngster, the coast artillery officers of the U. S. Army are trained to think in terms of defense in the event of a foreign fleet threatening one of our fortified harbors.

Typical of the war game played by the coast artillery officers is that shown in the accompanying illustration, taking place at Fort Andrews, near Boston. The table in the foreground is arranged as a huge relief map representing the Boston harbor. A naval expert maneuvers the "enemy fleet" while the curtain, shown at the right, is drawn. After making the proper disposal of his ships the curtain is pulled aside and each officer, who represents a battery commander, is asked to give a decision on his course of action within a certain number of minutes. This develops the ability to size up a situation and make a quick decision.



Copyrighted, International Film Service

**Playing the coast artillery war game on a relief map of Boston harbor at Fort Andrews, near Boston**

# Inventions New and Interesting

## A Department Devoted to Pioneer Work in the Arts

### A Demountable Reviewing Stand Which Will Hold One Hundred People

CONFRONTED with the necessity of erecting a demountable reviewing-stand, especially at the time when the missions of our Allies were being entertained, the Union League Club of New York city assigned the rather difficult task to a member, Eugene Southack. In conjunction with Harold Roberts, a consulting engineer, Mr. Southack developed a most ingenious structure which forms the subject of the accompanying illustration.

The demountable reviewing-stand, according to Mr. Southack's claims, can be erected in two hours' time, and after it has served its immediate purpose it can be taken down in about the same length of time. Three men are required for the work. By way of proving his claims, the designer recently had the structure completely taken down in less than two hours, and was then requested by the Club to re-erect the stand by two o-clock that afternoon. The men started at 12.30, and the stand was in position, ready to use, a few minutes before two o'clock.

Among the interesting features of the steel work are the bolts, which are all of the same length and diameter. The various members are so fabricated with shelf angles and erecting plates that their position in erecting is easily determined. It is impossible to put any one of the members in the wrong place. The wooden deck is notched over the steel members and held firmly in place by the railing which passes through the deck into sockets riveted to the main steel members. The railing of the stand is so constructed that the vertical members fold in order to occupy little space when dismantled. The entire railing when in place is held by four screws, and six flag-pole sockets are placed in the rail to hold any desired standards. When the stand is dismantled and stored the sockets in the sidewalk are covered with small brass plates, screwed in place with spanner wrenches.

Mr. Southack's reviewing stand does not block the sidewalk; indeed, it clears the sidewalk by a sufficient margin to permit the tallest pedestrians to pass under it without discomfort. The size of the stand is 25 feet by 10 feet, and it can hold 100 people without undue crowding. Because of the step construction of the deck, the reviewing officers have an uninterrupted view; in addition, a reviewing bay five feet in diameter greatly enhances the usefulness of the stand. When completely dismantled the structure can be stored in a space measuring 15 feet by 6 feet. Lastly, the strength of the structure is always a known factor, and for this and other reasons it has been approved by the New York City Building Department.

Demountable reviewing-stand erected in front of the Union League Club on Fifth Avenue, New York

### An Ammeter Designed Along the Lines of the Electric Lamp

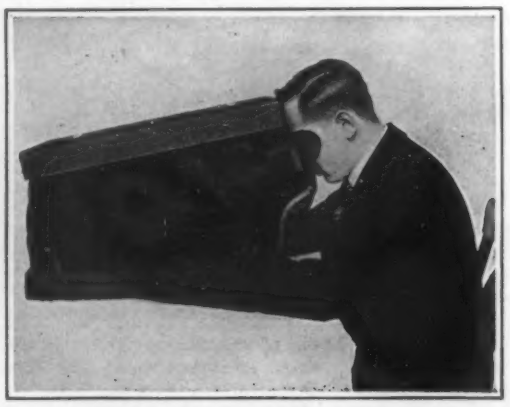
FOR measuring small currents of both the alternating and direct kinds there has recently been developed a simple instrument which is designed primarily as a maximum current gage, to indicate the condition of syntony in wireless circuits. This instrument may also be employed as a substitute for a thermo-junction and galvanometer combination in the measurement of wave-lengths and decrements.

The principles of the new ampere gage is that of the bifilar suspension, one pair of the filament ends being fixed and the other pair attached to a pivoted arm, the rotation of which is controlled by a spring against the tension of the filaments. When a current passes through the filaments, heating them and causing them to elongate, the arm takes up a new position, and the angular displacement, as indicated on the scale, is a measure of the current. The movement, as will be noted in the accompanying illustration, is inclosed in a glass bulb exhausted of air, thus greatly increasing the sensibility of the meter and protecting the movement against damage and dust and corrosion. To simulate still further the design of the conventional electric lamp, the new meter is provided with either a bayonet socket or Edison screw base, although other forms are made with terminal caps at both ends. In the new ammeter the variation in zero, which usually characterizes thermal instruments, is said to be negligible, and the movement is very dead-beat. The instrument is available as a low reading voltmeter or ammeter, or as a shunted ammeter, having a normal resistence of about 12 ohms. A high resistance pattern has a resistance of 30 ohms. These gages have maximum readings of 0.11 amp. and 0.035 amp., 1.44 and 1.25 volts, respectively, and read down to 0.02 amp. and 0.007 amp. The cross arm seen in the illustration carries two pointers for reading amperes and volts respectively.

With a wavemeter using the new vacuum gage the wave-length of a primary circuit of a 1½ kilowatt set can readily be read when the wavemeter is held with the plane of its inductance parallel to that of the primary of the oscillation transformer at a distance of two feet to three feet. The noise of the spark, which often hinders the reading of a wavemeter by means of rectifying crystal and telephones, in the case of the vacuum gage gives no trouble since the condenser is simply manipulated until the maximum reading is obtained with the gage. The vacuum gage greatly simplifies the tuning of wireless circuits, and makes for greater accuracy. It is understood that this meter will soon be available in ranges from 50 amp. to 500 amp.


Ammeter recently designed for wireless telegraph purposes

Everything and anything that is done in a dark room can be done with this equipment



Looking through a light-proof hood, an operator can carry on any dark-room work with perfect ease and comfort

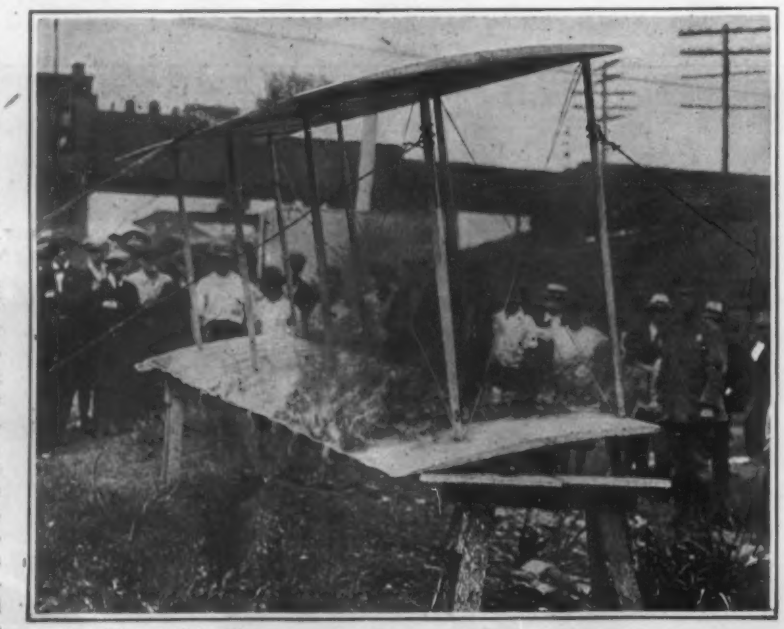
### A Dark Room Which Travels with the Photographer

WEIGHING but seven and one-half pounds when completely collapsed, and ready to be carried about with the convenience of a small suit-case, the portable dark chamber recently perfected by A. Benko of New York city should prove of interest to photographers having need for such equipment.

The portable dark room can be used equally well in daylight or artificial light, indoors or outdoors. It obviates the darkening of a room, or the fitting up of a special room for photographic work, hence does away with objectionable gases and vapors arising from kerosene lamps and other illuminants apt to prove injurious to sensitized surfaces. Another great advantage of this apparatus is the fact that the operator need not put his head inside the dark chamber, but can work freely outside of it, performing the necessary manipulations with his hands simply inserted through light-tight cuffs that afford ample elbow freedom.

However, should the operator wish to view the work in hand he can do so by looking through a light-excluding hood, which has two shutters that open automatically when the face is pressed against it, and that close automatically as soon as the pressure is released. A large opening with lightproof cover is cut in the top of the box, whereby the operator is enabled to place his dishes and plates very conveniently. In this cover is adjusted the ruby glass window, which may readily be removed so as to substitute an orange or any other colored glass for handling autochrome plates. The dark chamber is well ventilated.

There is provided a convenient pocket in the chamber to be used as a receptacle for plateholders. Thus the portable dark room can be said to replace fully the conventional dark room for all kinds of developing work. It enables a photographer to develop his negatives immediately after making his exposures, which is obviously a great advantage.





This biplane wing, treated with a newly-invented fireproof varnish, went through a fire test without appreciable damage

### Can the Aeroplane be Made Fireproof?

TESTS recently made with a fireproof aeroplane-wing varnish in Newark, N. J., were successful to a point where it seems reasonable to expect a practically fireproof aeroplane in the near future. And once the modern aircraft is made fireproof one of the greatest dangers which the passengers of an aeroplane are now

*(Concluded on page 166)*

### The Heels of Achilles

*(Concluded from page 151)*

fleet from most disastrously shelling New York city.

The reason for this is that a fleet coming to attack New York would necessarily be superior to any defending force and would keep several hundred miles back of its scouting line. It must also be assumed that the scouting line could overwhelm anything we could send against it. Such a screen would sweep everything before it, and chase away or destroy all submarines before the fleet would approach the coast, and even then it would not come in without being surrounded with its screens.

There are still some others who pin their faith to mines and believe that these when protected by shore fortifications and operated in conjunction with submarines are sufficient for sea-coast defense.

It is pertinent to quote t stimony from Vice Admiral Sims who before he was detailed to command the destroyers now operating with our allies was president of the Naval War College, and prior to that was commander of the submarine and destroyer divisions. He has gone on record as saying in reply to this contention, that:

"Unless you can support mines and submarines with a superiority of surface craft, there is no difficulty in an enemy's getting either out of the way. Any expedition that comes over would have two or three screens in front of the main body. These screens would be about 10 miles apart and any submarine attempting to get underneath these screens, must come up before reaching the main body and when he does he must stay on the surface as by then he would have finished his submerged run. As for mines we have no difficulty in sweeping them out of channels."

So at last it all comes back to the dreadnought, the backbone of the navy, the ultimate force with which to meet aggression. The question is frequently asked, "if a 400-ton submarine can sink a 40,000 ton dreadnought what is the use of building more dreadnoughts?" But the submarine cannot do it, at least they have not done it during the three years of the present war. The only dreadnought which has succumbed to an underwater blow is the British "Audacious" and it is not generally known whether it was a mine or a torpedo that sent her to the beach with one or more compartments flooded.

That our own later types of dreadnoughts have been made impervious to torpedo attack was indicated by the testimony of Rear Admiral Taylor, the chief constructor of the navy, before the House Naval Committee. He did not give details as these are confidential. But it is well known that prior to the building of the Pennsylvania type of dreadnought there had been extensive experiments with caissons built to represent sections of hull and that one after another the caissons were blown in by torpedoes until one was at last designed that could withstand the shock. Thus the name of this super-type of battleship, the majestic dreadnought, becomes even more luminous.

Possessed of a sufficient number of these, with battle-cruisers, destroyers, submarines and auxiliaries so proportioned as to make up a well balanced fleet, and this country could easily forego any further appropriation for coast defenses except for the maintenance of those already constructed.

### Eliminating Disease from the Casualty List.

*(Continued from page 159)*

chamber through iron tubes arranged like organ pipes. The heat circulates from bottom to top, passing through other pipes arranged inversely to the former. In this heating apparatus, the complete sterilization of numerous tubes, bottles, flasks, etc., takes place in 20 minutes, for the heat diffuses uniformly throughout the chamber, in place of being simply transmitted by a plate of sheet iron, and distributed unequally, as in ordinary laboratory ovens.

The special apparatus for the solution process is used also for the distribution

*(Concluded on page 165)*

## RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

### Pertaining to Apparel

BELTLESS COAT.—M. BERKWITS, 57 and 59 East 11th St., New York, N. Y. In order to produce the desired result in this invention, use is made of a body consisting of an upper portion including sleeves and a collar and a lower portion spaced from the upper portion, a band being inserted permanently connecting the upper and lower portions with each other, the band insert being in contrast with the upper and lower portions and simulating a belt.

### Pertaining to Aviation

AIRSHIP.—J. B. STAGE, Hurricane Mills, Tenn. A specific object of the invention is the provision of a novel propelling mechanism which is adjustable, to enable an ascent in a vertical line, and then adjustable to permit of flight in a horizontal line, there being an arrangement of planes used in combination with the propelling means whereby the planes are operative during horizontal flight, and inoperative during ascension or descension.

### Electrical Devices

TELEPHONE TRANSMITTER.—J. P. FERRITER, address Thos. J. Peters of Peters, Fla. A specific object of the invention is the provision of a transmitter in which alternating current is produced in the primary circuit through the agency of a condenser, one set of plates of which is connected with the diaphragm of the transmitter in order to produce alternate positive and negative charges resulting in the production of alternating current in the induction coil primary connected with the other set of plates of the condenser.

BUZZER TRANSMITTER.—J. P. FERRITER, address Thos. J. Peters, Peters, Fla. In this patent the object is to provide a buzzer transmitter for the purpose of telegraphing over a wire telephone circuit or for use as a telegraph transmitter over a wireless telephone circuit, or for use as a telegraph transmitter in induction telegraph devices designed to operate on telegraph or telephone wires to provide an additional telegraph circuit over such wires, or for use as a telegraph transmitter wherever a high frequency alternating current is required and when the requirements include the elimination of brush discharges.

TELEPHONE TALKING-COIL AND CIRCUIT CONNECTIONS.—J. P. FERRITER, address Thos. J. Peters, Peters, Fla. The object of the invention is to produce a simple and efficient talking coil which produces a greater amplitude of variation in the current induced in the talking coil secondary winding when the transmitter is in operation than can be produced with an ordinary talking coil and ordinary connections, the current flow being the same in both cases

ELECTRIC-WIRE EMBEDDER.—F. W. LUEBECK, Knox, Ind. The invention relates particularly to a device for use in imbedding, in the wax foundation of a bee comb the wires of the supporting frame. It is the practice to send an electric current through the wires to heat the same and cause them to melt their way into the foundation. Ordinarily the full length of wire is heated, this requires considerable time and electric current. In this invention means are provided, whereby the current will be directed successively through short sections of the wire thereby requiring a small current, the device serving to heat the complete wire step by step along its length.

### Of Interest to Farmers

WEED-CUTTER.—B. T. LANE, 54 Cremona St., Seattle, Wash. One of the principal objects of the invention is to provide a weed-cutter with a plurality of sets of cutting blades, the blades being adjustably connected to a frame, which latter is bodily adjustable whereby the height and angular relation of the cutting blades with the ground may be readily changed and correctly maintained, the frame on which the cutting blades are carried is provided with colters arranged in advance of the blades for opening slight furrows and preventing the blades from clogging.

### Of General Interest

LEAD HOLDER.—W. K. HOLMES, 409 Pearl St., New York, N. Y. The invention provides a lead holder, a tube for carrying the lead, means for moving the lead out of the tube, the tube having a V-notch disposed transversely of the tube near the end where the lead is adapted to project out of the tube, and an open sleeve on the tube having a V-projection entering the V-notch for engaging frictionally a lead located in the tube, whereby the lead is prevented from falling out.

CHARGING AND DRAWING OF POTTERS' OVENS.—M. P. FERNEYHOUGH, Stoke-on-Trent, England. The changing or placing of saggars in a potters' oven is a long an laborious process. This invention comprises for provision within the oven a portable and collapsible vertical guantree fitted with lifting and lowering devices or hoists, together with one or more adjustable horisontal arms whereby the saggers can be conveyed between the hoist and any part of the oven interior.

POLE-CLIMBER.—C. WINTER, 1113 C. Ave. E., Oskaloosa, Iowa. The invention relates to a climbing device for linemen the object being to provide an arrangement whereby a pole may be climbed in safety and if desired without the use of either of the hands. A further object is to provide a device which may be clamped firmly to the foot without interfering with the usual movement of the foot when walking on the ground.

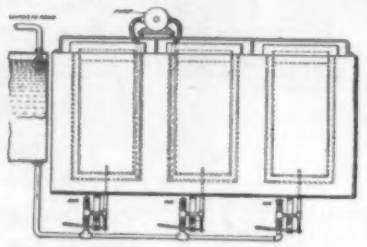
RAT-TRAP.—T. V. CLAPP, 346 Main St., Springfield, Mass. The general object of the invention is to improve and simplify the construction of a trap so as to be efficient in use and comparatively inexpensive to manufacture and to form an effective entrapping means. The trap is of wire mesh having a door formed of a plurality of independently moving members, which swing inwardly to premit the animal to enter, but which are prevented from swinging outwardly.

TOILET BOWL.—M. J. CARROLL, Room 6, 88 Broad St., Elizabeth, N. J. The object of the invention is to provide a toilet bowl which may be readily disinfected, the bowl having in its side a well in communication with the interior of the bowl at and above the water seal, so that a disinfectant may be introduced into the bowl through the communication above the water seal, and the disinfectant may be fed to the bowl through the communication at the water seal.

GARTER.—A. BAUMANN, Address G. A. Pohl, 215 7th St., West New York, N. J. The invention has for an object the provision of a garter which may readily act as an elastic band around the leg or as a suspending member. A further object is to provide a garter with a connecting button and a clip arranged with a pair of slots or notches for receiving the button when the garter is in different positions, so as to connect the garter for producing a band when in one position, and connect it to a hose when in another position.

COLLAR AND STIFFENER THEREFOR.—M. FINKELSTEIN, 1800 Seventh Ave., New York, N. Y. The invention relates to soft shirt collars and its object is to provide a stiffener for the neck band with a view to maintaining the shape of the turndown portion, holding the neck-band more or less out of contact with the neck to prevent perspiration from wilting the collar, especially the turn down portion. Another object is to permit of conveniently removing the stiffener, while the collar undergoes the usual laundrying.

SANITARY ICE-MAKING APPARATUS.—W. W. HAGOOD, Charlotte, N. C. The prime object is to provide a highly efficient sanitary apparatus, the parts of which may be constantly inspected and maintained at small cost in perfect operating and cleanly condition. The type



AN END VIEW OF THE TANK

of apparatus is one employing tanks having compartments in which rows of cans are supported, surrounded by brine and ammonia or other coils, the cans being supplied with water which is frozen by the brine or cold air and freezing coils, the cans are removable for the purpose of dumping the blocks of ice.

### Hardware and Tools

LIFTING-JACK.—H. I. BENEDICT, 1902 Broadway, New York, N. Y. A specific object of the invention is to provide a jack in which the elevating element embodies a buttress screw which is engaged by releasable dogs on the vertically movable section of the jack there being novel means for releasing the dogs so that the jack can be easily and quickly collapsed and at the same time the screw and dogs permit the vertically movable element to be raised or pulled out without operating the gearing, thus enabling the jack to be quickly adjusted to the load to be lifted.

DOOR-LATCH.—E. P. HARLEY, care of Gladstone Apartments, Apt. B, Texarkana, Ark. The invention has for its object to provide a simple device especially adapted for use on automobiles, refrigerators and the like, wherein a slight pressure or a hard slam in closing the door will cause the latch to act surely, there being no possibility of the door being opened until the latch is operated, the commencement of the movement of the latch to release the door, automatically opens it.

CULVERT PIPE.—H. O. BERNARD, care of The Butt-Joint, Nestable Culvert Co., Birmingham, Ala. In this invention each length of pipe consists of similar sections, and each of the sections is provided at one end with a bell portion, the bell portions of the sections cooperating to form a complete bell when the sections are properly fitted together. Each section is provided with circumferential reinforcing ribs which at their ends are enlarged, to form a species of head at each end of each rib.

EXPANSION STUD BOLT.—G. C. RAEGER, Waterloo, N. Y. The object is to provide an expansion stud bolt more especially designed for use in connection with concrete walls, posts and other structures. The bolt consists of an expansible member adapted to be inserted in a hole in the structure and a bolt having a driving and locking member adapted to be driven into the said expansible member to expand the latter in the hole and to be fastened to the said expansible member to maintain the bolt in position outside of the hole.

### Heating and Lighting

LIGHT BRACKET.—I. BERKOWITS, 93 East Houston St., New York, N. Y. The invention relates particularly to light brackets adaptable for use in connection with shop sewing machines. The objects are to eliminate the large number of threads used for maintaining the drop light, to permit the adjustment of the light to the machine to suit the operator, and to provide a light bracket having means for carrying thread spools.

### Machines and Mechanical Devices

SPROCKET.—C. F. RUNNER, 1606 Broadway, Bellingham, Wash. The invention relates to sprockets such as are used on bicycles, the main object is to provide means for changing the speed of revolution from low to high and the reverse at will, a further object is to provide means whereby, when in high speed and a coaster break is applied, the sprocket is automatically shifted to low speed, and upon continued forward pedal movement after brake release, said sprocket is again automatically shifted to high speed.

WINDMILL.—G. S. SOLOMON, address Zeno La Brier care of A. M. Sames Scheerer Bldg., Douglas, Arizona. This invention relates to wind mills having turbine wind wheel elements together with means to automatically throw the wheel out of operation upon a predetermined increase of the wind. The prime objects are to provide a wind mill in which separate power units may be assembled in any desired number, and a wind deflector arranged to direct the wind to the power units and to be automatically given a partial turn, to deflect the wind away from the power units.

WRAPPING MACHINE.—C. BECKMANN, care of E. D. Anderson 81 6th St., Long Island City, N. Y. The invention relates to a machine construction for automatic cartoning machines, bottle-wrapping machines, package making-machines, etc., and it deals more particularly with means for automatically feeding cartons, bottles packages or the like, to and from the various mechanisms which go to make up the machine.

GOLD-CONCENTRATING PLANT.—N. L. RABER, 121 North 8th St., Corvallis, Oregon. The invention relates to a plant for concentrating gold, and referes to a distributer for the plant for controlling the distribution of the matter to be concentrated to the concentrating tables. The object is to provide a simple destributer between the grizzly and concentrating tables, whereby the amount of matter to be concentrated, which passes through the grizzly may be evenly distributed over the concentrating tables.

### Medical Devices

HYPODERMIC SYRINGE.—B. T. TRUEBLOOD, 2140 6th Ave., West Seattle, Wash. This invention has for its object to provide a syringe having a tube constructed with a socket to receive a nipple on a syringe removably disposed in the tube so that a local anesthetic may be disposed in the tube which will pass through a nipple on the tube corresponding to the nipple on the syringe and to a needle mounted on the tube nipple, when the syringe is given an inward movement relatively to the tube. The syringe nipple fits in the tube socket to permit of a subsequent injection by the use of the syringe while there is an airtight connection between the tube nipple and the syringe nipple.

### Prime Movers and Their Accessories

CARBURETER.—C. MORGAN, Pine Grove, W. Va. The invention is an improvement in vacuum carbureters and has for an object to provide a carbureter of the character specified and of the "Venturi" type. A further object is to provide mechanism between the inner and outer casing for constraining the preheated air to encircle and inclose the inner casing to move in close contact with the wall thereof, and wherein the said air is also constrained to move close to the fuel supply in order to heat the said supply.

ENGINE CONTROL.—H. L. GERKEN, 57 W. 91st St., New York, N. Y. The invention relates to means for controlling internal combustion engines, and particularly to means for simultaneously controlling the ignition and fuel supply. It can be applied to any internal combustion engine having a carbureter and timer. Another object is to provide a control in which the fuel delivery opening is varied inversely of advance ignition.

### Railways and Their Accessories

RAILWAY TRACK TRUSS.—D. FINKELSTEIN, 920 Prospect Ave., Bronx, N. Y. An object of the invention is to provide supporting means for railway rails of such a nature as to reduce to a minimum the deflection in the rails laterally as well as up and down, thereby producing a stiffer track. A further object is to provide supporting means of such a nature that danger of derailment will be prevented or lessened, such occurrences resulting largely from the spreading of the rails.

CROSSING SIGNAL.—W. A. HESSE and P. G. SANBORN, address Percy G. Sanborn, care of National Signal Co., San Francisco, Cal. The invention provides a railway crossing signal which will oscillate and which will be automatically lighted when in opreation, the light and the signal arm operating in connection with a gong or other sound producing device. Another object is to arrange a driving mechanism for the swinging arm that the arm will begin and cease its movement promptly, the various parts being locked when not in operation, so that accidental movement of the arm cannot take place, the invention is of simple construction with a minimum number of parts not easily thrown out of order.

### Pertaining to Recreation

GAME APPARATUS.—R. M. BRENNER, Box 51, Palisade, N. J. The object of the invention is to provide a game apparatus for use in pleasure resorts, or in the form of a toy for children to aid them in learning rapid addition. The apparatus comprises a table provided with a rail and open at one end to permit of rolling a ball over the table, the head end of the table being provided with spaced pockets for the ball to pass into, and counters mounted to turn on a vertical axis in the said rails, each counter having peripheral members projecting beyond the inner face of the corresponding rail into a possible path of the ball rolled over the table.

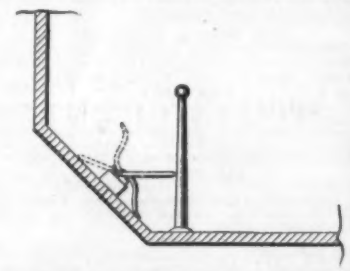
CHILD'S WAGON.—R. I. BORDNER and A. E. EBERHART, Brock, Saskatchewan, Canada. The invention relates to a hand-propelled wagon, the general object is to provide an efficient propelling means simple in construction and easy o-operation, to provide a steering means associated with the propelling means, but adapted to be operated and controlled without effecting the movements or positions of the propelling means, the objects are attained by providing a wheeled driven axle, and a vertically rocking propelling lever having a pitman connection with the driving element.

### Pertaining to Vehicles

APPARATUS FOR BENDING AND SETTING STOCK.—J. W. HICE, Box 128, Johnson City, Tenn. The invention relates to machines for bending of stock for forming wheel rims, fellies, table rims, and aprons. The invention provides a cap board that constitutes purely a resistance bar when inserted between the ends of the stock and in connection with the restraining band means are provided to connect the ends thereof, and to tension the connecting means for taking up any slack in the restraining band and insuring the retention of the curvature of the bent material until same has becomê set, the result being accomplished without any depression of the cap board or the exertion of end pressure on the layers of the material being bent.

SPARE-TIRE CARRIER.—K. FEILCKE, care of Pathfinder Co., Indianapolis, Ind. The invention relates to carriers for spare tires or spare wheels on automobiles the main object being to provide means which overcome the faults when spare tires or wheels are carried on the running board or at the rear of the car, the present means provides for spare tires to be carried in a casing, suspended from the chassis of the automobile beneath the body whereby they may be protected from theft, dirt, rain, etc., no great physical effort being needed to store or to remove them, by this means the rattling of the tires so common now is overcome, and the covers are dispensed with.

SAFETY LATCH FOR AUTOMOBILE GEAR-SHIFT LEVERS.—A. A. STILL, Annette, Calif. The principal object in this invention is to provide a latch mounted in a suitable position on the foot or dashboard of an automobile, acting to prevent accidental movement of the gear-shift



SHOWING SAFETY LATCH ON FORWARD PORTION OF AUTOMOBILE

lever into reverse position, thus doing away with the danger to life and limb, and the danger of injury to the mechanism of the automobile, the latch is normally retained by gravity in position to prevent movement of the gear shaft lever into reverse position.

PNEUMATIC TIRE.—J. DRUMMOND, Address Carl Spuhel, 437 Lowndall Ave. So., Kansas City, Mo. The invention relates to a tire in which separate cells will be formed of pneumatic sections complete and independent as to their shoes or casings and the securing means for the sections, and provides for attaching or detaching any particular cell without affecting the adjacent cells, the puncturing of an individual cell will not therefor effect the remaining cells.

VEHICLE WHEEL.—P. NURSE, Little Ferry, N. Y. The object of the invention is to provide a wheel with spokes extending radially from a hub, a felly being provided to each spoke, and their being means for holding in position a rim which is disposed around the fellies, said rim being constructed of flexible material, to permit a pivotal movement of the fellies by which means the desired resilience of the wheel is obtained.

HEADLIGHT CONTROL.—C. J. LANTIS, Chapman, Kan. The invention has for its object to provide mechanism in connection with headlights for motor vehicles, for constraining the lights to swing with the wheels, to direct the beam of light over the path to be traveled, an adjustable connection is provided between the steering mechanism and the controlling mechanism for the headlight, permitting a limited movement of the steering mechanism, without effecting the headlight control.

### Designs

DESIGN FOR A LIGHT REFLECTOR.—A. H. GOLLINGS, 843 Princeton St., Akron, O. Figure 1 in this design shows a top plan view, the side view is shown in Fig. 2, and the front in Fig. 3. The design is simple and light.

DESIGN FOR AN EMBLEM.—HARRIET E. BLANKS, care of Mrs. S. J. Miller, 579 24th St., Oaklapd, Cal. The design is in the form of a pin or broach showing the figure of a bird, suspending from a light chain held in its beak, certain forms of letters.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

## Eliminating Disease from the Casualty List

*(Concluded from page 163)*

of the vaccine into the capsules. It consists of a square wooden table which rests on four metallic feet, and surmounted by a cylindrical standard in the rear, designed to receive the flask containing the liquid to be transferred. The rubber stopper which closes this receiver is pierced by two holes; in the first is a straight glass tube through which there passes air compressed by a foot bellows. The second orifice, arranged laterally, affords passage to a glass siphon through which the liquid passes. A glass bell arrangement serves as a cap to the flask or capsule so as to prevent contamination by germs in the atmosphere in the course of the operations.

The apparatus for the distribution of the vaccine into capsules has been arranged to economize time as well as space. To increase the output and diminish the fatigue of the persons assigned to its operation, one of the collaborators of the laboratory, M. Blondel of the Sorbonne, modified some of the important details of the construction, so that by the improved apparatus, four persons can work simultaneously with the same machine. Seated around the table opposite each other, each has before him a flask of the liquid to be transferred, a tube to convey the air and a cock operated either by the handle or by a pedal. The foot bellows has been replaced by steel cylinders from which compressed air is distributed in all the rooms.

Independently of the anti-typhoid vaccines, there are prepared also under the direction of Professor Vincent, and according to the same technique, the anti-paratyphoid vaccines A and B, and the triple vaccines for anti-typhoid and anti-paratyphoid use, or vaccines T A B, intended to combat the two paratyphoid affections that are quite different from typhoid fever, although presenting analogous symptoms. A true and correct diagnosis for these maladies is secured by the appearance of the cultures obtained from the blood of the patient.

Here then are our little glass tubes, sealed and labeled, which straightway are issued to the surgeons for the inoculation of the troops. The surgeon's assistant, after having sterilized by boiling the glass hypodermic syringe, the needle, and the nippers which serve to break off the end of the flask containing the vaccine, disinfects with tincture of iodine the region of inoculation, which is often the shoulder. Then the surgeon inserts his hypodermic needle, and slowly and steadily injects the vaccine under the skin, a little below the shoulder blade. Three or four successive inoculations of the vaccine T A B, at weekly intervals, confer absolute immunity. However, in the army zone, or in case of emergency, two vaccinations suffice for checking impending epidemics.

### Behind the Cantonments

*(Continued from page 156)*

10,000 men work on each cantonment, meaning a pay roll of up to $150,000 weekly. Two hundred men, half of them governmental, do nothing but keep time on a cantonment job. Many cantonments have from three to five hundred *foremen*—each doing his section of the big job. In every case the contractor has quit all the rest of his work and gone and lived on the job!

And this great work—which must be practically completed by September 1st—in 80 working days—*has been done!* True, there will be loose odds and ends to finish—the time was absurdly short and the work enormous beyond power of words to make evident. But while not "completely finished" all the cantonments will be ready for use on the date set. Strategic and political reasons made it vital that the new army have a home ready and waiting for it when called into existence. There is no boomerang of failure for either Col. Littel's machine or Major Starrett's committee in the amazing results which will so soon be prominent in the public eye.

The biggest emergency construction job the world has ever seen, in point of magnitude, of cost, of economy, of time, of quality and of completeness, has been

well accomplished not only because American contractors knew their jobs but because there was absolutely nothing behind the picking of the organization which did the actual construction but a scientific selection of the one best man for the one right place.

## Can the Aeroplane be Made Fireproof?

(*Concluded from page 162*)

subject to will have been wholly eliminated.

The tests in question were performed before officials of the Aero Club of America, the French Aeronautical Commission, the United States Signal Corps, and a large group of aeronautical experts. First of all a section of standard biplane wing coated with the usual varnish or "dope" employed throughout the world was splashed with a small quantity of gasoline and set on fire. As can well be imagined, the conflagration spread rapidly, and in less than 30 seconds the wing was entirely consumed.

Then followed a test in which another biplane wing section, which had been treated with the fireproof varnish, was drenched with gasoline and a torch applied to the upper and lower wing by United States Inspector Howell. Although the gasoline immediately flared up with a mass of hot flames, the conflagration soon died out. To the amazement of the spectators the fabric of the wings was found to be intact, although here and there it was slightly discolored and scorched. Further trials confirmed this first test with the fireproof varnish, and in each case the wing fabric went through the fire without serious damage. Equally interesting is the fact that the frames of the wings came through the test without any buckling or warping.

## How Forest Fires Are Discovered and Reported

THE comparatively little damage done by the hundreds of fires that have occurred so far this season on the National Forests in California is due largely to the fast work in discovering and reporting them by the lookout men, according to forest officers.

The National Forests are constantly under the eyes of trained watchers stationed on high peaks during the fire season. There are 85 lookouts in the National Forests in California. Their work demands ability to concentrate, keen eyesight, and quick judgment. No lookout man is considered efficient who does not discover, locate, and size up a fire within three minutes from the time the smoke first appears above the tree tops. Two minutes more are allowed him to get the dispatcher on the telephone and deliver his report. The standard of the Forest Service demands that the dispatcher in turn shall not be longer than two minutes in communicating with the ranger nearest the fire, delivering instructions, and starting the fire suppression force in motion.

This takes much practice on the part of the lookout man particularly, and in order to keep him up to the mark and to test out his speed and accuracy, forest inspectors occasionally set false fires or smudges. The lookout's job is said to be one of the loneliest in the world, and is comparable to that of the lighthouse keeper on a rockbound coast, with this difference: The lookout man is under a strain 16 to 18 hours a day watching for fires. He is hired for the summer months only, and is usually a homesteader, miner, or prospector during the rest of the year.

The lookout houses are built on peaks from 6,000 to 10,000 feet high, usually miles from the nearest human habitation. They are often exposed to the full force of the winds and storms. Several houses have been struck by lightning during recent years, although they are studded with lightning rods. When Mt. Lassen first broke into eruption a few years ago, the lookout house on the rim of the crater was smashed to kindling wood.

The house is seldom more than a one-room square box, its sides largely of glass and its furnishings so arranged that even while cooking and eating the occupant is able to keep his eyes on the forest. Supplies are packed in to the lookout weekly by the forest rangers. Water and wood he must obtain himself, and at night. Watch is not kept for fires during the hours of darkness. The lookout's means of communication are the telephone and heliograph, and travelers through the forest, attracted by mirrorlike flashes of light on some high peak. may be observing a lookout man reporting fire by "sun talk" or receiving the latest gossip of camp and range.

The discovery of fire by stationary lookouts is a comparatively recent development in the National Forests. Before this method was used, it often happened that fires burned for days before discovery. It is now seldom that a fire is not discovered within a few minutes after its origin. Further developments in the fire discovery and suppression system of the Forest Service are exposed. The wireless telegraph has been installed in one forest in the southwest, and a lookout man circling above the forest in an aeroplane, it is said, was used to great advantage last summer in the East. At the conclusion of the war it is expected that the aeroplane method of fire detection may become common in the National Forests of California.

## Cement Joints for Cast-Iron Pipes

CEMENT joints for cementing cast-iron pipes have been recently described as entirely feasible and successful. At Long Beach, N. Y., there are 60 miles of cast-iron water mains, ranging from four to 24 inches in diameter and laid with such joints. They are all under pressures of from 40 to 80 pounds per square inch. A prominent engineer's recent description of the method of making these joints is as follows:

He recommends the use of dry jute, free from oil or grease, instead of oakum for the foundation ring. The Portland cement is to be placed dry on a piece of canvas (a torn sack) under the joint, and to be moistened and mixed to a consistency so that when gripped firmly in the hand the paste should retain its form, but crumble if dropped from a height of 12 inches. The paste is then to be hand-packed into the joint, and to be hand-rammed with a caulking tool until the socket is half full. The joint is then to be filled and caulked with an iron tool and heavy blows with a hand-hammer, until the cement is thoroughly packed, and the packing to be continued until the joint is nearly full. A small bead of neat cement in plastic condition is then put on, using the caulking tool for smoothing like a trowel. After the cement has set, the joint is to be covered with earth so as to protect it from the air and sun. The back-filling of the excavated material is to be settled with water. About 20 per cent of the cement is generally wasted. The joint is allowed to stand 48 hours before the pressure is turned in. It is stated that such cement joints will stand a great deal of rough treatment, and that settlements to the extent of three inches and more have occurred without destroying the seal. As regards cost, according to the written communication of another member a cement joint is cheaper than a lead joint, but more expensive than one made up with "leadite."

## Production of Opium in Japan

THE Japan *Chronicle* states that as a result of the greatly reduced imports of chemicals and medicines after the outbreak of the war, the domestic demand for opium greatly increased. By way of promoting the home manufacture of drugs, it says, the government has encouraged the cultivation of the poppy and the preparation of opium. The output accordingly increased in an appreciable degree last year, amounting, as shown by the lastest investigations, to 2,525 pounds. According to the *Chronicle* the principal prefectures producing opium are Osaka, Okayama, and Wakayama, followed by Kochi, Aichi, Nara, and Fukuoka.

## Welded Ships

WELDING cast steel sections together into ships is one of the latest propositions for speeding up shipbuilding. Briefly the idea is to build a hull in sections, each a casting as large as the conditions will allow, and to weld the castings together electrically by an arc method. One casting might constitute the bottom of the vessel for a section eight feet in the dimension lengthwise of the ship; another casting would form practically one side of the hull for that section, and a third the corresponding side opposite; a fourth casting would form part of the deck framework or the stiffening between the upper parts of the sides. The scheme is thus to build a large number of substantially identical sections, so that the work may be carried out in duplication in many centers and at the same time it is intended to afford a means of adding rapidly to shipbuilding capacity without depending upon the rolling mills, which are already fully engaged. Midship sections would, of course, be duplicated to a large extent, and then for the corresponding parts of standardized ships the identical castings would be used. The abutting edges of castings would be bevelled to form the V-shaped grooves used in electric welding and by means of interlocking lugs and overhanging ends the cast sections would be drawn together to bring the edges into exact registration, to be welded electrically. In the size of the castings, section 8 feet by 30 feet might be used or even larger if the plant permitted it. The grooves are on the inside of the hull, leaving the outside of the ship without projections other than the minute ones corresponding to the surface of a steel casting untouched from the sand. The only work contemplated necessary on the outside would be the removal of chipping of the steel fins following the use of built-up forms of mold, which may be used for the large castings. The inner skins of the vessel to form bulkheads, ranks and bunkers, may be composed of rolled-sheet metal welded to the decks, beams, frames and plating. There would be the necessity in this type of construction for the castings to be reinforced to secure strength to the hull itself as well as to provide for satisfactory casting results. On a close examination of this method it cannot be said that there is a great likelihood of its having much success, as the work involved might very possibly be lengthened through broken castings, and rivetting by pneumatic power is not yet out of date or superseded by any more successful method.

## Some Observations on Office Building Lighting

AN important step can be made in office building lighting by cooperation of the architect and engineer in the location of outlets. according to S. G. Hibben in the *Transactions* of the Illuminating Engineers Society.

Frequently the deciding factor in the choice of fixtures is the ease of cleaning and low maintenance cost. Quality of illumination and appearance of fixture are also important. The cleaning cost is one of the greatest items of maintenance. However, the money is well spent, because where maintenance is not good an increase of illumination amounting to 30 per cent has been obtained when the fixtures are cleaned. To facilitate cleaning attention should be given to the construction of the fixture and the relative positions of the bowl and lamp. In many offices there is a tendency to mount the lamps too low. It is usually good practice to employ no more than three sizes of bowls and no more than four sizes of lamps to simplify maintenance.

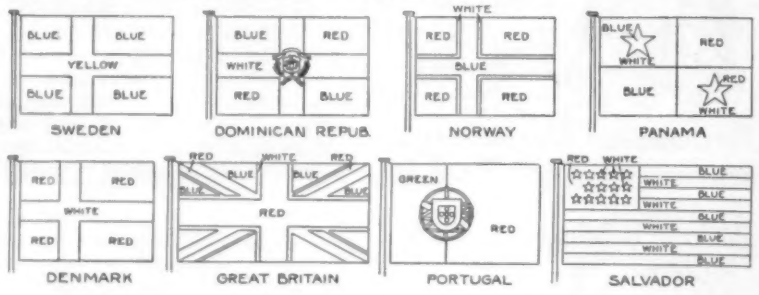
Care in selecting the interior finish of a room is very important. For instance the substitution of cream-colored for green walls will increase the desk illumination by 17 per cent. Substitution of ivory-white ceilings and cream-colored walls for cream ceilings and green walls will net an increase of 32 per cent in illumination. With totally inclosed globes the substitution of cream colors for green walls increases the desk top illumination to 27 per cent.

# How To Tell the Flags

## By Albert A. Hopkins

What are the flags of our numerous allies?

What are the flags of our enemy and their allies? These questions are often asked and are hard to answer without reference to a dictionary, an encyclopedia or an expensive book on flags. With the aid of the following chart any of the flags of the 57 chief countries can be determined at a glance. Eight flags do not lend themselves to the system employed and are therefore given separately in picture form. It will be found that all the others resolve themselves into plain fields, those with surcharges on the fields, stripes horizontal, varying from two to thirteen, and three bars vertical. With a little practice any flag can be determined by the use of the chart. The number of flags of many countries is considerable owing to variations for army and navy use, but the flags as outlined on this chart are the *usual* flags which would be displayed on a ship, the variations for special services are legion.




**Plain Fields with or without Additions**

Green—Yellow Diamond with Globe—Brazil
White—With Red Ball—Japan (Merchant) see special cut
Red —New Republic of Russia (Socialist flag). National flag see three stripes below
Red —Morocco
Red —Siam—White Elephant
Red —Switzerland, with White Cross
Red —Tunis, White Ball with Star and Crescent in red on ball
Red —Egypt, with Star and Crescent in white
Red —Turkey, with star and Crescent in white

**Interrupted Field**

Red —With Union Jack in Corner. Merchant Flag of Great Britain (see cut of Union Jack)
Blue —With Union Jack in Corner, Royal Naval Reserve of Great Britain (see cut)
White—With Union Jack and St. George's Cross, Naval Flag of Great Britain

**Two Stripes Horizontal**

White and Red—There is a blue union with a white star occupying part of the white—Chile
White and Blue—San Marino
Blue and Red—Wide Stripes—Haiti
Red and White—Monaco

**Three Stripes Horizontal**



Horizontal Bar Type Stripe

| *Top* | *Middle* | *Bottom* | *Remarks and Additions* |
|---|---|---|---|
| Red | White | Red —Austria Hungary | —Miniature of stripes on escutcheon on white half of lower bar green in merchant flag with arms |
| " | " | Blue —Luxembourg | —Blue very light |
| " | " | " —Netherlands | —Dark blue |
| " | " | " —Paraguay | —Dark blue, badge on white |
| " | Yellow | Green —Bolivia | —Arms on yellow |
| " | Blue | White—Servia | — |
| " | " | " —Montenegro | —H. I. and crown on blue |
| Blue | White | Blue —Argentina | —Light blue |
| " | " | " —Honduras | —Dark blue with 5 stars on white |
| " | " | " —Nicaragua | —Light blue anchor on white |
| Yellow | Blue | Red —Colombia | —Yellow broad, blue (light) white star in oval on Merchant flag |
| " | " | " —Ecuador | —Yellow broad, blue (dark) |
| " | " | " —Venesuela | —7 stars on blue stripe |
| Green | Yellow | " —Abyssinia | |
| " | White | Rose —Persia | |
| White | Green | Red —Bulgaria | |
| " | Blue | " —Russia | |
| Black | White | Red —Germany | |

**Four Stripes**

Narrow Blue, white, wide red, white—blue (light blue throughout) Costa Rica

**Five Stripes**

Red—Yellow—Blue—White—Black—China
Yellow—Red—Wide Yellow—Red—Yellow—Spain
Blue—White—Blue—White—Blue, White star in red triangle at staff—Cuba

**Nine Stripes**

Blue—White—Blue—White—Blue—White—Blue—White—Blue, Union White Cross on Blue—Greece
Blue — White—Blue—White—Blue—White—Blue—White—Blue—White—White Union with face in Sun—Uruguay
Blue—White—Blue, etc., red canton with 14 white stars—Salvador (see cut above

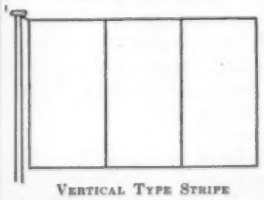
**Eleven Stripes**

Red—White—Red—White, etc., with Union, blue ground and one white star.—Liberia

**Thirteen Stripes**

Red—White—Red and White—Red and White, etc., with a Blue Union, and 48 White Stars—United States of America

**Three Bars Vertical**



Vertical Type Stripe

| *Nearest Staff* | *Middle* | *End* | |
|---|---|---|---|
| Black | Yellow | Red —Belgium | |
| Blue | White | " France | |
| " | " | Blue—Guatemala (Light Blue) | |
| Green | " | Red—Italy. Shield with white cross on red field in blue border | |
| " | " | " —Peru | |



## "Waterproof" A Matter of Definition

WEBSTER'S 1912 Dictionary defines the adjective "waterproof" thus: "covered or coated with a material, as a solution of rubber, to prevent permeation by water; impervious to water." Yet the term is generally applied to any article that has been treated by a process to make it resist water.

A man who is going to slosh about in water up to his waist or up to his chest must have a truly waterproof garment, and he will presumably select it of some grade of rubber goods. But if he is merely going for an outing in a place where it is likely to rain down on him, he may not want the rubberized article. In such case, the salesman will probably offer him some kind of a specially processed fabric, with the assurance that it is waterproof. If the customer will but hold it up to the light he may be able to see the houses on the other side of the street through it; yet, though his common sense should tell him that no hole can be waterproof, he accepts the selling argument and buys the garment. When experience teaches him that it is only necessary for it to rain hard enough in order that he get wet through his new coat, he is highly indignant; but where is the fault?

The fact is, the term waterproof is used to cover two distinct kinds of merchandise—the truly waterproof garment which will hold back water like a dam, and the processed cloth which is merely resistant to water penetration, and which, if there but be enough water, will get wet through.

No fabric can be genuinely waterproof unless the pores between the fibers are either completely filled up or wholly covered over with some substance insoluble in water. This does not mean that a fabric cannot keep out inclement weather unless so treated, for there are many ways of treating cloths which enable them to stand a certain degree of saturation without permitting the passage of water. The degree of resistance offered depends upon the closeness of the fabric itself and the character of the repelling medium.

# HARRISON

## ORIGINAL HEXAGON CELLULAR RADIATOR


Shutter Front Open


Shutter Front Closed

—*has freer water ways*—better circulation—better cooling capacity.

—*the thinnest core*—lighter weight —greater economy.

—*more generous air passages*—greater cooling efficiency.

—peculiar horizontal arrangement of cells give greater durability and strength.

You can get a better idea of its superiority by its work on these cars:

**CHANDLER, HUDSON, HUPMOBILE, MITCHELL, OLDSMOBILE, PEERLESS, COLUMBIA**
**also the**
**GRAMM and FEDERAL TRUCKS**

*Write for particulars. Ask about the Shutter Front on the Hudson.*

**HARRISON RADIATOR CORP.**
**Lockport, N. Y.**

*Furnished with Shutter Front for the HUDSON and COLUMBIA.*

---

# Judge by the Weight of Evidence

*Used for Years*

- American Woolen Company
- American Print Works
- American Writing Paper Co.
- Armstrong Cork Co.
- British-American Tobacco Co.
- Beechnut Packing Co.
- Crane Company
- Ford Motor Company
- General Electric Company
- B. F. Goodrich Company
- International Harvester Company
- Johns Hopkins University Bldgs.
- Procter & Gamble Company
- Swift & Company
- United States Steel Corporation
- U. S. Navy Dept. Mare Island

**LAPIDOLITH** TRADE MARK

**Dustproofs, Wearproofs and Waterproofs**

## Concrete Floors

Lapidolith the liquid chemical is easily flushed on old or new concrete floors. Its action is positive.

These names of leading American manufacturers carry weight. All have used Lapidolith in a big way.

If these concerns have spent thousands of dollars to preserve their concrete floors it is surely worth your while—

to write for all the evidence—testimonials, details and free sample.

Department 1

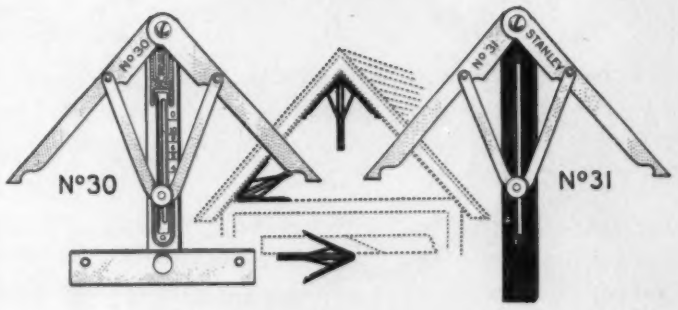
**L. SONNEBORN SONS, Inc.**

*Manufacturers of Cemcoat, the Washable Wall Coating*

**264 Pearl Street, New York**

---

# Stanley Tools




## STANLEY ANGLE DIVIDERS

All workers in wood have occasion to fit mouldings or other woodwork, into odd angles. To lay out the cut with an ordinary bevel necessitates the use of dividers and a second handling of the bevel, making three operations.

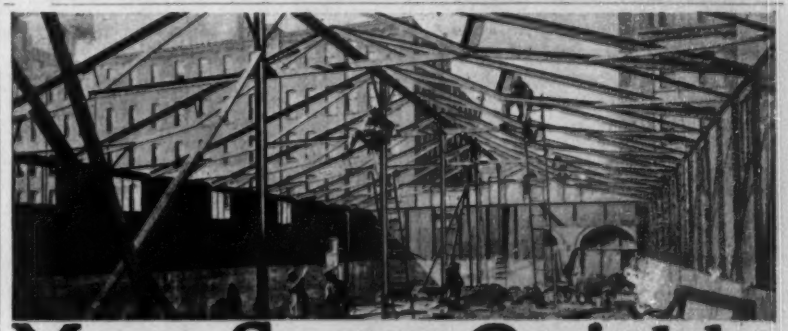
The Stanley Angle Divider is designed for performing this work at one setting and is practically a double bevel. The two blades each fit one side of an angle and the handle gives the center line. The cut is marked from the center.

In the No. 30, which is entirely of metal and nickel plated, the handle is graduated on the under side for laying out 4, 6, or 8-sided work, and—by means of a removable "T" head (see cut), it can also be used as a "T" square. No. 31 has a rosewood handle, is not graduated, and has no "T" head.

*For Sale By Hardware Dealers*

**STANLEY RULE & LEVEL CO.**
**NEW BRITAIN, CONN. U.S.A.**

---



# More Space Quickly

Manufacturers, business men, railroads, cities, and the nation itself, today face the problem of providing *more space quickly.*

Truscon Steel Buildings are being erected everywhere to meet just such emergencies. These are not temporary, make-shift structures, but strong, permanent, *all-steel buildings*—well ventilated, weather-tight, fireproof, and splendidly daylighted.

**Truscon STEEL BUILDINGS** PORTABLE PERMANENT

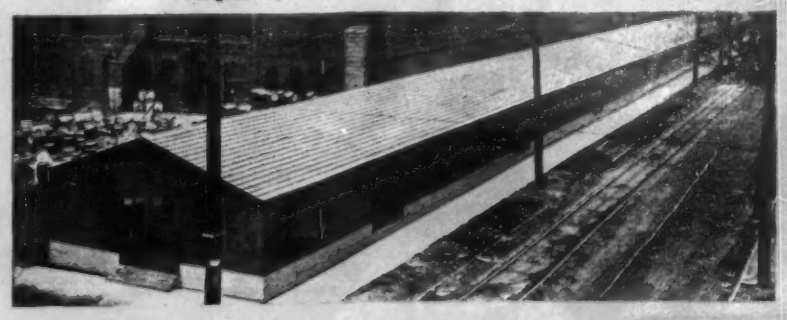
are provided with steel sash, steel doors and steel-tile roof. Easily portable—can be taken down and re-erected in a new location with no loss or depreciation. The interchangeable steel units are quickly assembled by means of a simple locking device. Standard buildings are practically all widths and all lengths.

Truscon Steel Buildings answer all requiremets for use as modern factories, offices, machine shops, storehouses, schools, hospitals, boathouses, railroad sheds, etc. Approved by city building departments.

Save time! *Write today* for catalog and estimates—give size and purpose of building. Address Dept. P-2.

**Trussed Concrete Steel Company**
Youngstown, Ohio


Truscon Steel Warehouse. The Jos. N. Smith Company's plant, Detroit, after fierce fire. Inflammable contents of building uninjured. Note where firemen attempted to cut their way through.




*Ten Lights in One*

**Ten Exclusive Features**

1 Cylindrical doubled shutter eliminating glare.
2 Three reflecting surfaces.
3 Instantly adjusted focus.
4 Large 4-inch diminishing mirror.
5 Twin universal bracket for all cars.
6 Five feet electric cable, terminals.
7 Parallel beam Nitrojector searchlight bulb.
7a Pilot bulb.
8 Scientific installation and cork moisture protector.
9 Simplified "on" and "off" control.
10 Exclusive torpedo, 8-inch body.

**OLD SOL NITROJECTOR MODEL 100**

*Price* $10

# *Courtesy*

## Safety and convenience make the Old Sol Nitrojector No-Glare Windshield Driving Light an absolute necessity.

It has banished forever the danger of glare, at the same time giving a most powerful driving light at the instant control and focus of the driver, in any and every direction.

Safeguards every mile of night travel in city, town or suburban highways—eliminates the danger of treacherous curves—finds road signs—locates in plenty of time walkers on the side paths,or unlighted wagons—makes passing of other cars safe and *always without glare—a law-obeying light for every state in the Union.*

For day use has the large adjustable 4-inch mirrorscope attached.

The Nitrojector special bulb No. 2045 affords a full driving power light with an astonishing reach and throwing power.

Other Old Sol Windshield Driving Lights: No. 77—price $5. No. 70—price $7. Both have exclusive Old Sol focusing device, mirrorscope and five feet of electric cable.

Stocked by Every Jobber—Sold by All Dealers. Catalog Free

***Manufactured and Distributed by***

**HAWTHORNE MANUFACTURING COMPANY, INCORPORATED**

**43 Spruce St., Bridgeport, Connecticut, U. S. A.**

# SCIENTIFIC AMERICAN

SWEEPING OUT CAPTURED DUG-OUTS WITH A BROOM OF FIRE—[See page 179]

September 8, 1917

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents

DU PONT AMERICAN INDUSTRIES


# Uncle Sam Knows the Real Answer:

# NOT ENOUGH!

## Save Leather for Soldiers

For Automobile Tops and Upholstery

For Boat Cushions and Upholstery

For Furniture Upholstery

For Bags, Trunks, and Suitcases

For Book Binding

For Home Decorations Novelties, Belts, etc.

TO MAKE America's hide supply go as far as possible, hides are being split into five or more thin sheets; but, even this saving scheme fails to meet the requirements for soldiers' shoes, harness, equipment, ship upholstery, factory needs, etc., chiefly because too much hide leather is used by the public in places where high grade leather substitutes will serve as well or better.

For instance, the leather upholstery of one average size automobile would make twenty pairs of soldiers' shoes. For years America's largest producers of automobiles have successfully used Motor Quality Fabrikoid for upholstering their cars. Thousands of owners never even knew their cars were not upholstered in leather, because Fabrikoid looks and feels just like the finest leather and actually wears better than the coated split leather most used for upholstery of automobiles not covered with Fabrikoid.

Again, the furniture you buy with leather upholstery is probably covered with split leather that will not give service equal to

DU PONT FABRIKOID
REG. U. S. PAT. OFF.

## Craftsman Quality

That "genuine cowhide leather" suitcase of yours will probably reveal on inspection that its covering is only a pasted-on piece of split leather not much thicker or stronger than this sheet of paper.

It is true that some few high priced automobiles and pieces of furniture are upholstered in genuine grain leather of good quality, and bags and suitcases are to be had at a price that are made of thick grain cowhide.

But the pride of possession of luxurious, expensive leather should now yield to patriotic preference for satisfactory substitutes that will divert this leather to more necessary uses.

### Uncle Sam Has Set the Pace

The new U. S. motor trucks and ambulances will be upholstered in leather substitutes.

For several years the standard for book binding in the Government Printery has been Du Pont Fabrikoid.

The upholstery specifications for the new Merchant Marine call for "Craftsman Quality Fabrikoid."

What Uncle Sam has found by experience and tests good enough for the Government's severe requirements should be good enough for every loyal American.

### How You Can Help

If you are a manufacturer using leather, probably part or all of your requirements can be met by some grade of Fabrikoid. While not feasible for every use of leather, the illustrations herewith show its wide range of utility.

If you use leather in your home for any purpose, try the proper grade of Fabrikoid instead.

When buying an automobile, boat or piece of furniture prefer Fabrikoid upholstery. Help the manufacturer conserve leather by patronizing those who use good leather substitutes like Fabrikoid.

Every hide displaced by a good substitute helps supply our armies with shoes, our farms with harness and our factories with belting—it helps win the war.

Manufacturers! write us your requirements and let us cooperate with you.

Americans everywhere! write for samples and names of manufacturers of the article you want who use Fabrikoid and of stores near you selling it by the yard.

## DU PONT FABRIKOID COMPANY

WILMINGTON DELAWARE

*World's Largest Manufacturers of Leather Substitutes*

**Factories at Newburgh, N. Y., Elizabeth, N. J., Fairfield, Conn., Toronto, Ont.**

DU PONT